Accepted: 14 November 2016
DOI: 10.1111/sms.12816

ORIGINAL ARTICLE

WILEY

Attacking 22 entries in rugby union: running demands and differences between successful and unsuccessful entries

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Global Positioning System (GPS) technology is commonly utilized in team sports, including rugby union. It has been used to describe the average running demands of rugby union. This has afforded an enhanced understanding of the physical fitness requirements for players. However, research in team sports has suggested that training players relative to average demands may underprepare them for certain scenarios within the game. To date, no research has investigated the running demands of attacking 22 entries in rugby union. Additionally, no research has been undertaken to determine whether differences exist in the running intensity of successful and unsuccessful attacking 22 entries in rugby union. The first aim of this study was to describe the running intensity of attacking 22 entries. The second aim of this study was to investigate whether differences exist in the running intensity of successful and unsuccessful attacking 22 entries. Running intensity was measured using meters per minute (m min^{-1}) for (a) total distance, (b) running distance, (c) high-speed running distance, and (d) very high-speed running distance. This study provides normative data for the running intensity of attacking 22 entries in rugby union. Forwards achieved greater high-speed running intensity in successful (3.6 m min^{-1}) compared to unsuccessful (1.8 m min^{-1}) attacking 22 entries. Forwards should try and achieve greater high-speed running intensity in attacking 22 entries to increase the likelihood of successful outcomes during this period of gameplay.

KEYWORDS
football, physical fitness, running, sports

1 | INTRODUCTION

Global Positioning System (GPS) technology has been used extensively to quantify the average running demands of rugby union.[1–3] Despite the volume of research using GPS technology in rugby union, no studies have reported simultaneously on GPS metrics and performance. In rugby league, it has been reported that condensed periods of repeated high-intensity efforts (RHIE) are common prior to scoring or conceding a try.[4] Also, at varying levels of rugby league competition, it has been reported that lower level teams perform more RHIE prior to scoring than higher level teams, while higher level teams complete more RHIE prior to conceding a try.[5] An increased playing intensity, as quantified by an increase in RHIE, often occurs prior to a try being scored in rugby league,[4] but this has yet to be explored in rugby union. To date, no research in rugby union has attempted to relate GPS-derived running metrics to the likelihood of a positive outcome.

Research has reported on the average running demands of rugby union games, using GPS technology.[1,2,6] Using meters per minute (m min^{-1}) as a measure of running intensity, research has reported similar findings when using total distance (TD); an average of 65 m min^{-1}, 69 m min^{-1}, and 65 m min^{-1} has been reported by Jones et al.,[2] Cunniffe et al.,[1] and Cunningham et al.,[7] respectively. An average of 76 m min^{-1} and 81 m min^{-1} has also been reported.[6,8] The averages reported by Lindsay et al.[8] and Reardon et al.[6] were derived from distance per game time minutes, which accounts for the higher m min^{-1} compared to previous research. Average running game demands do not reflect the demands of the most intense periods of gameplay. Unpublished data from our research group has observed that long periods of ball-in-play have a higher running intensity (125 m min^{-1}) compared to average running demands.

Attacking 22 entries in rugby union are of key importance; teams must pass through the opposition 22 zone (complete a successful attacking 22 entry) to score a try. It has been shown in previous research that winning teams score significantly more tries compared to losing teams.[9] Research has investigated the results of rugby games with winning teams partaking in significantly greater attacking 22 entries than losing teams.[10] Rather logically, winning teams achieved points more frequently than losing teams for each attacking 22 entry.[10] Despite the knowledge of how important attacking 22 entries are in rugby union, there remains a lack of research investigating potential ways to increase the likelihood of success in these scenarios. Methods that need investigation may include, but are not limited to, physical output, skill execution, and style of play.

It is expected that an opposition defense would be more likely to succumb to attacking pressure following repeated defensive efforts. The logic is to force the opposition into more RHIE, causing fatigue and therefore an increased likelihood of conceding a try or penalty. Unpublished data from our research group has observed that increased running distance and total distance are associated with an increased number of open-play involvements. It is plausible that higher GPS-derived running metrics would increase involvements in attacking 22 entries, thus increasing the likelihood of a positive outcome.

The first aim of this study was to describe the running intensity of attacking 22 entries and compare these to average game demands. The second aim of this study was to investigate whether differences exist in the running intensity of successful and unsuccessful attacking 22 entries. The hypothesis was that higher GPS-derived running intensity would result in an increased likelihood of successful attacking 22 entries.

The running demands of attacking 22 entries described in this study will provide practitioners with comparative metrics, which could be utilized to guide training intensity in attacking 22 entries. It may be recommended that practitioners ensure that athletes are above the intensity of attacking 22 entries in training, to ensure they are prepared for such scenarios in competition. Should differences be identified in successful vs unsuccessful attacking 22 entries, this would provide important metrics for practitioners to focus attention on with regard to this specific scenario in rugby union.

2 | METHODS

2.1 | Subjects

Forty-three professional rugby union players were recruited for this study (age=27.8 ± 4.1 years; height=1.86 ± 0.07 m; body mass=104.5 ± 12.4 kg). The 43 players provided 470 GPS files from 11 games, in both the domestic league (Guinness Pro12) and the European Cup (European Champions Cup) during the 2015/2016 season. The average number of attacking 22 entries analyzed from each game was 3 (SD ± 1). The 43 players were subcategorized into position (number of players in each position): prop (n=8), hooker (n=4), second row (n=5), back row (n=9), scrum half (n=3), fly half (n=3), centre (n=3), back three (n=8). The breakdown of GPS files from each position (number of files) was as follows: prop (n=64), hooker (n=32), second row (n=60), back row (n=96), scrum half (n=31), fly half (n=38), centre (n=41), back three (n=108). Of the 11 games, seven games were won and four games were lost. Ethical approval for data collection on these players was approved by the University Human Research Ethics Committee.

2.2 | Procedures

All players wore an individual GPS microtechnology unit (Catapult S5, 10 Hz, Catapult Innovations, Scoresby, VIC, Australia) in a bespoke pocket fitted in their jersey, between the scapulae. Each GPS unit had a sampling frequency of 10 Hz, which has proved the most reliable in team sports for measuring distances and speeds.[11] The GPS units were taped into the pocket to ensure they were not displaced during competition. The GPS units were turned on and off upon arrival to the stadium for the game and switched on again 15 minutes prior to the game to ensure the highest quality of satellite signal, as recommended by the GPS provider. No estimated data were included in the sample. Data for attacking 22 entries were coded live in Openfield software (versions 1.8.2 - 1.11.0) during gameplay.

Outcomes from attacking 22 entries were coded as successful or unsuccessful, with a description of the event occurring in the final play of each entry. A "successful" attacking 22 entry would entail one of the following outcomes: a try being scored, a penalty being awarded, a dropkick being scored, or any retention of possession (eg, being held up over the try line). An "unsuccessful" attacking 22 entry would entail any form of loss of possession: turnover, penalty conceded, knock-on, or into touch. A total of 32 attacking 22 entries were analyzed in this study, 19 of which were successful and 13 unsuccessful.

These GPS-derived metrics investigated in this study were as follows:

1. Total distance: the cumulative distance covered at all walking and running intensities.

2. Running distance: the total amount of distance covered above 2.2 ms^{-1}. Long and Srinivasan[12] reported 2.2 ms^{-1} as the mean transitional speed between walking and running.
3. High-speed running distance: the total amount of distance covered above 60% of the player's individual max velocity (Vmax).[6] Speed zones were individualized in accordance with the findings of Reardon et al.[6] that reported an under- and overestimation of HSR with the use of absolute speed zones in forwards and backs, respectively, in rugby union. The highest velocity achieved by a player in the past three seasons of data collected from all training sessions and games was used as the individual Vmax. Training sessions included dedicated speed sessions.
4. Very high-speed running distance: the total amount of distance covered above 80% of the player's individual Vmax.

Metrics from GPS were investigated in a "per-minute" method (m min^{-1}) to evaluate intensity and to allow for comparison of all entries disregarding duration of attacking 22 entries. Attacking 22 entries less than 20 s of play were discounted, to avoid an excessively high per-minute figure for metrics that would give a false representation of running intensity. If a maul/scrum event occurred at the start of an attacking 22 entry, data from GPS and duration only commenced when the scrum/maul event was completed. Collisions were not included in this analysis due to current GPS technology's inability to validly quantify collisions in rugby union.[13] Reardon et al.[14] have highlighted that current GPS technology under- and overestimates collision count, when compared to video analysis. Accelerations and decelerations were not included in our study, due to reported issues over the validity of quantifying these metrics with current GPS technology.[15,16]

2.3 | Statistical analysis

2.3.1 | Attacking 22 entry running intensity compared to average game running intensity

For each position, a separate MANOVA was undertaken to investigate differences in the running intensity of attacking 22 entries compared to average game demands. The four dependent variables (*all described as m min*$^{-1}$) were as follows: (a) total distance; (b) running distance; (c) high-speed running distance; and (d) very high-speed running distance.

2.3.2 | Positional differences in attacking 22 entry running intensity

A one-way between-groups MANOVA was performed to investigate positional differences in the running intensity of attacking 22 entries. The independent variable was position (with eight levels). The four dependent variables (*all described as m min*$^{-1}$) were as follows: (a) total distance; (b) running distance; (c) high-speed running distance; and (d) very high-speed running distance.

2.3.3 | The worst case scenario for successful and unsuccessful attacking 22 entries

The interquartile ranges for both successful and unsuccessful attacking 22 entries were determined to describe the upper range of running intensity (*the worst case scenario*) for each of the following variables (*all described as m min*$^{-1}$): (a) total distance; (b) running distance; (c) high-speed running distance; and (d) very high-speed running distance.

2.3.4 | Positional differences in successful and unsuccessful attacking 22 entry running intensity

For forwards and backs, a multivariate analysis of variance was undertaken to investigate differences in the running intensity between successful and unsuccessful attacking 22 entries. The four dependent variables (*all described as m min*$^{-1}$) were as follows: (a) total distance; (b) running distance; (c) high-speed running distance; and (d) very high-speed running distance. In instances whereby there was a perceived substantial difference in the estimated marginal means between successful and unsuccessful attacking 22 entries, the univariate results were also considered (*with the application of a Bonferroni adjustment*).

For each position, a multivariate analysis of variance was undertaken to investigate differences in the running intensity between successful and unsuccessful 22 entries. The four dependent variables (*all described as m min*$^{-1}$) were as follows: (a) total distance; (b) running distance; (c) high-speed running distance; and (d) very high-speed running distance. In instances whereby there was a perceived substantial difference in the estimated marginal means between successful and unsuccessful attacking 22 entries, the univariate results were also considered (*with the application of a Bonferroni adjustment*).

Partial eta squared effect sizes were calculated and reported as recommended by Cohen.[17] The cutoffs for effect sizes used were small (0.01), moderate (0.06), and large (0.14).[17] These have been reported in the results alongside the numerical effect sizes.

3 | RESULTS

3.1 | Attacking 22 entry running intensity compared to average game running intensity

For each position, there was a statistically significant difference on the combined dependent variables ($P \leq .01$). When the results of the dependent variables were considered separately, both total distance and running distance were statistically significant for all positions (Table 1). Additionally, for the second row, back row, scrum half, and back three positions, very high-speed running was also significantly difference (Table 1).

3.2 | Positional differences in attacking 22 entry running intensity

Regarding positional differences in attacking 22 entry running intensity, there was a statistically significant difference on the combined dependent variables, F (28, 1656)=2.16, $P \leq .01$; Wilk's lambda=0.88, partial eta squared=0.03 (small). When the results of the dependent variables were considered separately, both high-speed running (F [7, 462]=4.31, $P \leq .01$, partial eta squared=0.06 [moderate]) and very high-speed running (F [7, 462]=2.62, $P \leq .01$, partial eta squared=0.04 [small]) were statistically significant. Results of the Bonferroni-adjusted pairwise comparisons are detailed in Table 1.

3.3 | The worst case scenario for successful and unsuccessful attacking 22 entries

The median value and interquartile range for successful and unsuccessful attacking 22 are detailed in Table 2.

3.4 | Positional differences in successful and unsuccessful attacking 22 entry running intensity

For forwards, there was no statistically significant difference between successful and unsuccessful attacking 22 entries on the combined dependent variables, F (4, 247)=1.69, P=.15; Wilk's lambda=0.97; partial eta squared=0.03 (small) (Table 3). Interestingly, the results of the univariate analysis revealed a statistically significant difference (P=.04) for high-speed running intensity between successful (3.6 m min^{-1}) and unsuccessful (1.8 m min^{-1}) 22 entries. The associated effect size was small (partial eta squared=0.02).

For backs there was a statistically significant difference between successful and unsuccessful attacking 22 entries on the combined dependent variables, F (4, 213)=3.85, P=.01; Wilk's lambda=0.93; partial eta squared=0.07 (moderate) (Table 3). When the results of the dependent variables were considered separately, running distance, high-speed running distance, and very high-speed running distance were significantly lower in successful attacking 22 entries, when compared to successful entries (Table 3).

For the prop position, there was no significant difference between successful and unsuccessful attacking 22 entries on the

TABLE 1 Attacking 22 entry running intensity compared to average game running intensity

	Total Distance (m min^{-1})		Running Distance (m min^{-1})		High-speed Running Distance (m min^{-1})		Very High-speed Running Distance (m min^{-1})	
	Average	Attacking 22 entries	Average	Attacking 22 entries	Average	Attacking 22 entries	Average	Attacking 22 entries
Prop [Jersey 1,3]	63.1 (59.2-67.0)	97.5 (88.8-106.0)[a]	29.8 (25.6-34.1)	53.7 (44.1-63.4)[a]	2.2 (1.3-3.0)	2.3 (−1.1-5.8)[b]	0.2 (0.0-0.4)	0.2 (−1.1-1.4)
Hooker [Jersey 2]	66.8 (59.4-74.3)	103.8 (91.7-116.0)[a]	34.1 (26.0-42.2)	63.2 (49.6-76.9)[a]	4.2 (1.9-6.5)	6.5 (1.6-11.4)	0.3 (0.1-0.5)	0.1 (−1.7-1.9)
Second Row [Jersey 4,5]	66.1 (61.0-71.1)	98.2 (89.4-107.1)[a]	32.9 (26.9-39.0)	51.5 (41.5-61.4)[a]	3.5 (2.4-4.5)	2.3 (−1.3-5.9)[b]	0.2 (0.1-0.3)	0.0 (−1.3-1.3)[a]
Back Row [Jersey 6,7,8]	68.8 (64.8-72.8)	100.9 (93.9-107.9)[a]	35.5 (30.8-40.2)	54.5 (46.6-62.3)[a]	3.5 (2.5-4.5)	2.4 (−0.4-5.2)[b]	0.2 (0.1-0.2)	0.0 (−1.0-1.0)[a]
Scrum Half [Jersey 9]	81.8 (74.1-89.4)	121.0 (108.7-133.3)[a]	43.2 (34.8-51.6)	76.8 (62.9-90.7)[a]	6.2 (2.4-10.0)	11.5 (6.5-16.4)	0.3 (0.2-0.4)	0.0 (−1.7-1.8)[a]
Fly Half [Jersey 10]	70. 7 (61.8-79.7)	106.7 (95.6-117.8)[a]	35.8 (26.3-45.4)	62.2 (49.7-74.7)[a]	4.0 (0.0-8.2)	7.0 (2.5-11.5)	0.5 (0.0-2.9)	2.6 (1.0-4.3)
Centre [Jersey 12,13]	71.0 (65.0-76.9)	105.9 (95.2-116.6)[a]	36.0 (29.3-42.7)	61.2 (49.2-73.3)[a]	4.5 (1.7 -7.4)	8.1 (3.8-12.4)	0.3 (0.0-1.5)	1.5 (−0.1-3.0)
Back Three [Jersey 11,14,15]	70.5 (63.4-77.7)	105.3 (98.7-111.9)[a]	32.9 (25.1-40.7)	58.8 (51.3-66.2)[a]	4.7 (1.4-8.0)	10.2 (7.5-12.8)	0.7 (0.0-1.9)	2.1 (1.1-3.1)[a]

m min^{-1}, meters per minute.
[a]significantly different to average.
[b]significantly different to back three.

TABLE 2 The worst case scenario for successful and unsuccessful attacking 22 entries

	Total distance (m min^{-1})		Running distance (m min^{-1})		High-speed running distance (m min^{-1})		Very high-speed running distance (m min^{-1})	
	Successful	Unsuccessful	Successful	Unsuccessful	Successful	Unsuccessful	Successful	Unsuccessful
Prop [Jersey 1,3]	97.5 (74.8-121.0)	90.5 (81.0-108.5)	52.5 (29.0-78.3)	54.5 (23.8-71.3)	0.0 (0.0-1.3)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
Hooker [Jersey 2]	100.0 (79.0-126.0)	93.0 (80.0-123.0)	55.0 (43.0-87.0)	58.0 (14.0-86.0)	1.0 (1.0-11.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
Second Row [Jersey 4,5]	96.0 (73.0-118.5)	96.0 (75.0-107.0)	44.0 (22.5-69.5)	44.0 (27.0-61.0)	0.0 (0.0-4.5)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
Back Row [Jersey 6,7,8]	95.0 (86.0-115.8)	96.0 (83.3-112.5)	48.0 (34.3-67.5)	46.0 (32.3-76.3)	0.0 (0.0-2.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
Scrum Half [Jersey 9]	117.5 (95.3-147.0)	127.0 (85.5-153.5)	64.0 (49.0-101.5)	75.0 (44.5-112.5)	0.0 (0.0-12.5)	3.0 (0.0-27.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
Fly Half [Jersey 10]	96.0 (83.3-112.5)	89.5 (80.8-144.5)	46.0 (32.3-76.3)	54.0 (30.8-103.0)	0.0 (0.0-0.0)	0.0 (0.0-8.5)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
Centre [Jersey 12,13]	92.0 (70.0-115.0)	121.5 (93.5-147.8)	44.0 (21.0-73.0)	80.5 (57.3-104.5)	0.0 (0.0-12.0)	0.0 (0.0-15.3)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
Back Three [Jersey 11,14,15]	96.5 (66.3-122.8)	102.5 (75.3-142.0)	51.5 (16.5-80.0)	53.0 (21.0-95.0)	0.0 (0.0-6.5)	0.0 (0.0-21.5)	0.0 (0.0-0.0)	0.0 (0.0-0.0)

Values are median (interquartile range (IQR)); m min^{-1}, meters per minute (Upper end of IQR represents the worst case scenario running intensity).

TABLE 3 Positional differences in successful (n=19) and unsuccessful (n=13) attacking 22 entry running intensity (forwards and backs)

	Total distance (m min^{-1})		Running distance (m min^{-1})		High-speed running distance (m min^{-1})		Very high-speed running distance (m min^{-1})	
	Successful	Unsuccessful	Successful	Unsuccessful	Successful	Unsuccessful	Successful	Unsuccessful
Forwards [Jersey 1-8] (n=252)	100.4 (95.7-105.1)	98.8 (93.2-104.5)	54.7 (49.2-60.2)	54.7 (48.0-61.3)	3.6 (2.5-4.8)[a]	1.8 (0.3-3.2)	0.1 (0.0-0.2)	0.0 (0.0-0.2)
Backs [Jersey 9-15] (n=218)	102.3 (95.3-109.4)	115.6 (107.3-123.9)	55.8 (48.1-63.5)[a]	71.6 (62.5-80.7)	6.2 (2.9-9.5)[a]	13.9 (10.1-17.8)	0.4 (0.0-1.6)[a]	3.8 (2.2-5.3)

Values are mean (95% CI); m min^{-1}, meters per minute; n, number of files.
[a]significantly different to unsuccessful.

combined dependent variables, F (4, 59)=0.25, P=.91; Wilk's lambda=0.98; partial eta squared=0.02 (small) (Table 4).

For the hooker position, there was no significant difference between successful and unsuccessful attacking 22 entries on the combined dependent variables, F (4, 25)=0.39, P=.81; Wilk's lambda=0.94; partial eta squared=0.06 (moderate) (Table 4).

For the second row position, there was a statistically significant difference between successful and unsuccessful attacking 22 entries on the combined dependent variables, F (3, 56)=2.89, P=.04; Wilk's lambda=0.87; partial eta squared=0.13 (moderate) (Table 3). Results of the Bonferroni-adjusted pairwise comparisons are detailed in Table 4.

For the back row position, there was no significant difference between successful and unsuccessful attacking 22 entries on the combined dependent variables, F (4, 91)=0.65, P=.63; Wilk's lambda=0.97; partial eta squared=0.03 (small) (Table 4).

For the scrum half position, there was no significant difference between successful and unsuccessful attacking 22 entries on the combined dependent variables, F (4, 26)=0.76, P=.56; Wilk's lambda=0.90; partial eta squared=0.10 (moderate) (Table 4).

For the fly half position, there was no significant difference between successful and unsuccessful attacking 22 entries on the combined dependent variables, F (4, 33)=1.32, P=.28; Wilk's lambda=0.86; partial eta squared=0.14 (large) (Table 4). Interestingly, the results of the univariate analysis revealed a statistically significant difference (P=.05) for high-speed running intensity between successful (2.2 m min^{-1}) and unsuccessful (13.6 m min^{-1}) attacking 22 entries. The associated effect size was moderate (partial eta squared=0.09).

For the centre position, there was a statistically significant difference between successful and unsuccessful attacking 22 entries on the combined dependent variables, F (4, 36)=2.68, P=.05; Wilk's lambda=0.77; partial eta squared=0.23 (large). Results of the Bonferroni-adjusted pairwise comparisons are detailed in Table 4.

For the back three position, there was no significant difference between successful and unsuccessful attacking 22 entries on the combined dependent variables, F (4, 103)=1.54, P=.20; Wilk's lambda=0.94; partial eta squared=0.06 (moderate) (Table 4). Interestingly, the results of the univariate analysis revealed a statistically significant difference (P<.05) for very high-speed running intensity between successful (0.7 m min^{-1}) and unsuccessful (4.1 m min^{-1}) attacking 22 entries. The associated effect size was small (partial eta squared=0.05) (small).

4 | DISCUSSION

When considering successful and unsuccessful attacking 22 entries, forwards achieved greater high-speed running

TABLE 4 Positional differences in successful (n=19) vs unsuccessful (n=13) Attacking 22 entry running intensity (positional)

	Total distance (m min^{-1})		Running distance (m min^{-1})		High-speed running distance (m min^{-1})		Very high-speed running distance (m min^{-1})	
	Successful	Unsuccessful	Successful	Unsuccessful	Successful	Unsuccessful	Successful	Unsuccessful
Prop (n=64) [Jersey 1,3]	99.4 (90.3-108.6)	94.5 (83.4-105.7)	55.6 (45.2-65.9)	51.0 (38.5-63.5)	2.8 (0.7-4.8)	1.7 (0.0-4.2)	0.3 (0.0-0.8)	0.0 (0.0-0.6)
Hooker (n=32) [Jersey 2]	107 (88.4-125.6)	97 (74.3-119.8)	66.2 (45.6-86.8)	55.7 (30.5-80.9)	7.8 (2.1-13.5)	2.3 (0.0-9.3)	0.2 (0.0-0.5)	0.0 (0.0-0.4)
Second Row (n=60) [Jersey 4,5]	96.9 (87.4-106.4)	100.4 (88.3-112.5)	49.1 (37.1-61.0)	55.3 (40.1-70.4)	3.5 (1.5-5.4)[a]	0.4 (0.0-2.9)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
Back Row (n=96) [Jersey 6,7,8]	101.6 (94.6-108.6)	100 (91.7-108.3)	54.2 (45.8-62.5)	54.9 (45.0-64.8)	2.8 (1.1-4.5)	1.9 (0.0-3.9)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
Scrum Half (n=31) [Jersey 9]	117.7 (99.2-136.2)	125.5 (103.7-147.2)	72.1 (52.0-92.1)	83.4 (59.8-107.0)	9.1 (0.0-18.5)	14.8 (3.6-25.9)	0.0 (0.0-0.1)	0.1 (0.0-0.2)
Fly Half (n=38) [Jersey 10]	104.1 (87.4-120.9)	110.2 (90.6-129.8)	57.9 (40.0-75.9)	68.1 (47.1-89.2)	2.2 (0.0-9.8)[b]	13.6 (4.6-22.5)	0.0 (0.0-4.4)	6.2 (1.1-11.4)
Centre (n=41) [Jersey 12,13]	93.6 (80.7-106.4)[a]	121.7 (107.2-136.2)	46.2 (31.8-60.6)[a]	80.4 (64.1-96.7)	5.0 (0.0-11.7)	12.1 (4.6-19.7)	0.0 (0.0-2.7)	3.3 (0.2-6.4)
Back Three (n=108) [Jersey 11,14,15]	100.5 (89.6-111.5)	112.2 (99.0-125.5)	53.9 (41.9-66.0)	65.8 (51.3-80.3)	7.2 (2.2-12.1)	14.6 (8.6-20.6)	0.7 (0.0-2.5)[b]	4.1 (1.9-6.3)

Values are mean (95% CI); n, number of files; m min−1, meters per minute.
[a]significantly different to unsuccessful on the multivariate analysis, [b]significantly different to unsuccessful on the univariate analysis.

intensity (3.6 m min^{-1} vs 1.8 m min^{-1}; small effect size) in successful entries. It may be interpreted that the greater high-speed running intensity for forwards in successful attacking 22 entries relates to their efforts in getting into position early to make themselves available for the next phase of play. The difference in physical output found in the current study opposes results found in rugby league, where greater amounts of high-intensity running and total distance did not relate to competitive success.[18,19]

Backs were characterized by significantly lower running intensity, high-speed running intensity, and very high-speed running intensity in successful attacking 22 entries compared to unsuccessful (moderate effect size). We posit that the higher running intensity for backs in unsuccessful attacking 22 entries is a direct result of forwards having a reduced high-speed running intensity. From observations of the data set, it is speculated that in unsuccessful attacking 22 entries, backs are forced to work harder to rectify the lower work rate of the forwards. When comparing the intensity of positional groups (Table 1), prop, second row, and back row had significantly lower high-speed running intensity compared to back three players.

Although not significantly different, it is evident that there are substantial differences in forward positional groups (prop, hooker, and back row) with regard to high-speed running intensity in successful vs unsuccessful attacking 22 entries (Table 4). Second row players showed a significant difference in high-speed running intensity in successful vs unsuccessful attacking 22 entries (Table 4). When grouping all the forwards together, there was twice the high-speed running intensity in successful attacking 22 entries, compared to unsuccessful (3.6 m min^{-1} vs 1.8 m min^{-1}, respectively) (Table 4). Some of the findings, despite the lack of statistical significance, may be of particular relevance to the practitioner. It was hypothesized that a higher intensity of GPS-derived running metrics would be evident in successful attacking 22 entries, when compared to unsuccessful entries. With regard to the metrics assessed in the current study, there were significant differences in successful vs unsuccessful entries, which are highlighted in Table 4. Gabbett [20] had previously found that there are no significant differences in high-speed running intensity (m min^{-1}) in matches won and matches lost in rugby league, when looking at the game as whole. It may be that looking at specific phases would provide a greater insight into the influence of running intensity on the outcome of scenarios, and thus the game. Gabbett [20] did suggest that a team's ability to maintain high playing intensity is linked to successful teams, and it may be that a team's work rate in phases of play influences the entire game. High-speed running intensity has also been compared in two rugby league teams in a tournament, whereby results showed a likely (81% chance; ES 0.52) higher high-speed running intensity in the high standard team (first division) when compared to a low standard team (third division).[21]

The greater high-speed running intensity for forwards in successful 22 entries provides interesting insight for practitioners to consider. Even within the confined space of the 22 zone, the importance of achieving greater than 60% (threshold for determining high-speed running) of top speed is clear. It is thought that a certain amount of effort is required to achieve 60% of top speed, particularly over shorter distances. Such effort is thought to translate into the increased likelihood of success in gameplay scenarios. It may be that players are accelerating harder in the 22 zone, to reach 60% of top speed and get into position early, thus providing greater attacking advantage. Limitations of current technology in quantifying high-intensity accelerations hinder the accurate analysis of these events.[15] It may be that the use of the high-speed running band (>60% V_{max}) used in this study provides an indirect measure of acceleration intensity within attacking 22 entries.

The current findings highlight the specific running demands of attacking 22 entries for rugby union, and the differences in these compared to average game demands (Table 1). All positional subgroups showed significantly greater total distance and running distance (m min^{-1}) in attacking 22 entries compared to average game intensity ($P \leq .01$). Interestingly, there were no significant differences in high-speed running intensity (HSR m min^{-1}) between attacking 22 entries and average game demands (Table 1). Second row, back row, scrum half, and back three positions showed a significantly different very high-speed running intensity in attacking 22 entries compared to average game demands (Table 1). From observations of the current data set, it is speculated that the higher very-high speed running intensity seen in the back three position in attacking 22 entries is from initial entry into attacking 22 entries and repositioning that may occur behind the phase of play.

The values in the current study may give practitioners insight into the application of training methods to specifically train the attacking 22 entry. However, using average demands may not result in preparedness for the worst case scenario of an attacking 22 entry. The upper limit of the interquartile range of both successful and unsuccessful entries (Table 2) may provide practitioners with the higher end of running intensity within this scenario.

These values may be used to train specific scenarios in rugby union to ensure that players are adequately conditioned for such scenarios in games. Using reports on average game demands to guide training may result in underpreparedness for specific periods in rugby union, such as attacking 22 entry scenarios. The evidence presented in the current study is similar to that reported in rugby league, in which different field position zones were found to have different physical demands.[22] The metrics in the current study for attacking 22 entries are below those observed by our research group for long outfield periods of play in rugby union players (105 m min^{-1} vs 125 m min^{-1} respectively; unpublished data The current running intensity figures may be used as a reference to ensure that rugby union players are adequately conditioned to handle the demands of attacking 22 entries. Previous research in Australian Football League (AFL) has shown that fitness levels (determined using the Yo-Yo IR2) influenced the high-speed running instensity of players in games.[23] Future research in rugby union should investigate whether an improved fitness level of players influences their high-speed running intensity within attacking 22 entries and whether that further improves the likelihood of success in these scenarios.

This study only investigated the running demands of attacking 22 entries. The addition of collision and acceleration activity to running intensity would provide practitioners with an overall picture of the physical output of attacking 22 entries. A measure of internal stress (heart rate) may provide a further level of player analysis, as the attacking 22 entry may be of high internal stress to the athlete, considering its proximity to scoring a try. When interpreting results from this study, it must be considered that these findings are from one team and tactics and skill level may differ in other teams.

Future research in rugby union should examine different running demands in different zones in the field related to attacking and defending. This would further guide practitioners in developing training that targets the specific running demands of scenarios in rugby union. Validation of acceleration and collision events derived from GPS microtechnology in rugby union would enhance the physical profiling of game events to further inform the practitioner.

5 | PERSPECTIVE

This is the first study to highlight differences in the outcome of specific scenarios in rugby union gameplay using GPS-derived running metrics. There is opportunity for future research to further investigate rugby union gameplay, from the game as a whole, and with regard to specific scenarios of gameplay (eg, defensive 22 entries and long periods of play). The importance of GPS-derived running metrics for rugby union in conditioning players for specific scenarios and evaluating the likelihood of successful outcomes is clear. In rugby union training and gameplay, forwards should be encouraged to achieve greater high-speed running intensity in attacking 22 entry scenarios, to increase the likelihood of success.

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