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Original Article

Analyzing physical demands of ball-in-play activity in young female rugby sevens athletes during matches

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Abstract
Assessing the intensity of gameplay and physical demands placed on athletes is crucial for sports practitioners to optimize athlete preparation for competitions. In Rugby Sevens, various methods can be utilized to gauge the physical workload and demands of the players, potentially yielding different parameters. Accurate assessment is imperative for providing coaches and practitioners with reliable insights into the physical requirements of a match. Relying on inaccurate references for athlete preparation could jeopardize sports success and increase the risk of injury. Thus, this study aimed to compare the locomotor demands of a Rugby Sevens match based on ball-in-play and whole-game average methods. Additionally, our study aimed to determine the worst-case scenario demands by analyzing long bouts of ball-in-play during matches. A total of 14 under-19 female professional rugby players participated in this study. The study analyzed the physical demands of a single match obtained using individual GPS. The results indicated that the whole-game averaging method underestimated the workload averages compared with the ball-in-play method. Additionally, the ball-in-play method was more sensitive to workload changes across half-times, and the worst-case scenario presented higher physical demands than the match averages. Overall, our results provide insights into the physical demands of Rugby Sevens and provide reference values that may be useful for coaches in planning the training of female Rugby Sevens athletes.
Keywords Monitoring methods; Match demands; GPS; Rugby Sevens

Introduction

Rugby Sevens is an intermittent sport characterized by repeated high-intensity collisions interspersed with periods of low-intensity activities and rest, and the capacity to repeat high-intensity efforts is correlated with success in the game (Austin et al., 2011; Roberts et al., 2008). Since the return of Rugby Sevens to the Olympic Games in Rio 2016, there has been a gradual increase in the intensity of game-play and the physical requirements of the players, who need to train adequately both aerobic and anaerobic fitness to accommodate the game's sporadic high-intensity nature (Duthie et al., 2005; Vescovi & Goodale, 2015).

Information regarding the match demands is vital for applied practitioners and for preparing athletes for the competition (Cunningham et al., 2018). The worst-case scenario (WCS) is known as the most demanding aspect of play (generally determined by the longest bouts of ball-in-play) within a given epoch length and needs to be accurately measured to be used as a reference for athlete preparation (Cunningham et al., 2018; Doncaster et al., 2020; Furlan et al., 2015; Gabbett, 2016). By correctly quantifying and understanding these demands coaches and practitioners may plan training sessions to simulate the WCS of match-play, allowing players to train and adapt to the most intense periods of competition (Cunningham et al., 2018; Furlan et al., 2015). Research has indicated that athletes should be training at the intensity of the WCS or higher to be well-prepared for competition and reduce injury risk (Cunningham et al., 2018; Doncaster et al., 2020; Gabbett, 2016).

Aiming to understand the demands of the game-play to design more specific training programs, player monitoring using microtechnology devices incorporating Global Positioning Systems (GPS) is now commonplace within high-level team sports. These technologies provide a valid, reliable, and practical method

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of quantifying players' external load during high-intensity exercises such as training and match-play (Rampinini et al., 2015; Varley et al., 2012; Whitehead et al., 2018). Although comparable research in international women's Rugby Sevens is limited, similar whole-match movement profiles have been reported. This information is useful to indicate the overall loads experienced, reporting players' responses across whole-match or half-times (Jones et al., 2015; Suarez-Arrones et al., 2014).

Even though data collected by GPS is useful in determining the workload and demands experienced by players during a game, measuring movement demands using half or whole-game averages (ROLL) might lead to inaccurate detection of peak demands (Delaney et al., 2018). Recent research has highlighted that when longer epoch lengths are used the intensity of the movement demands recorded decrease, suggesting that prescribed training loads may be insufficient (Cunningham et al., 2018; Doncaster et al., 2020; Sheppy et al., 2020). For this reason, accurately quantifying the WCS may avoid this underestimation, indicating that a more sensitive method must be employed (Delaney et al., 2018). In this regard, an alternative method was proposed to provide a more in-depth analysis of the physical workload and demands experienced by Rugby Sevens' players during a game, by using ball-in-play times (BIP).

Using BIP times, Reardon et al. (2017) reported that the WCS involves both alternating periods of high and low-intensity activity and is generally higher in intensity than research has previously reported when using only average demands. Pollard et al. (2018) also concluded that relative total distance (RTD) and high-speed running (HSR) were significantly higher when recorded using BIP times. This research using smaller periods of BIP further emphasizes the underestimation of the WCS when quantified using whole-game or half-game averages, since Rugby Sevens is an intermittent sport. However, only a few studies used BIP times in Rugby Sevens, and, to the best of our knowledge, no studies reported the demands of the game during female under-19 matches using the BIP method. One of the aims of this study is to compare the locomotor demands of a Rugby Sevens match measured by the BIP and the ROLL methods. Additionally, we aimed to compare the physical demands for each of the half times of a match according to these methods. Finally, our study aimed to determine the WCS demands through the analysis of the long-bouts of BIP during the match, to inform coaches and practitioners about the most demanding physical periods of the Rugby Sevens match. We hypothesize that the ROLL method will underestimate the workload averages when compared to the BIP method, that the BIP method will be more sensitive to workload changes across half times, and that WCS will present higher values of physical demands when compared to the match averages.

Material & methods

Ethical Considerations

The Committee on Research with Humans of the University approved this study (number 6.052.619; CAAE: 67661823.7.0000.8124). Participants signed the informed consent document for voluntary participation in the study.

Study design

This study employed a descriptive cross-sectional study design to examine and compare the physical demands of professional female rugby players with different methods of evaluation (BIP and ROLL method), and to determine the worst-case scenario (longest bout of ball in play) experienced by the players during a training-match with official rules of rugby sevens. Before the training match, a 15-minute warmup was conducted and a 4-minute rest interval was provided to the players between the warmup and the training match. Between half-times, a 2-minute interval was provided, such as the official rules of the game. The research was conducted in a single day, at the initial stage of the season.

Sample

The sample was defined by convenience and consisted of 14 female professional rugby players U19 (mean age of 17.3±1.02 years; mean rugby experience of 13.1±6.0 months; mean systematic training time of 26.5±18.6 months) who competed at national (Brazil) and international level, and who volunteered to participate in the study. Inclusion criteria for participation included participating in the game, not being injured, and competing at national and international levels. Athletes who did not meet one or more inclusion criteria were excluded from the sample. All players were in good health and injury-free at the time of data collection and no athletes were excluded from the sample.

Instruments

Physical demands For this study, the following variables were analyzed: total distance (m), relative distance (m/min), sprint distance (m), sprint distance per minute (m/min), and total and relative number of accelerations and decelerations, such as several other studies in Rugby Seven's (Ball, 2019; Furlan et al., 2015; Higham et al. 2016 Murray & Varley, 2015; Portillo et al., 2014; Suarez-Arrones et al. 2012). The GPS/GNSS 10Hz, with an inertial sampling rate of 400 Hz recorded at 100 Hz, Playertek model, produced by Catapult Sports®, Melbourne, Victoria, Australia, was used. In addition, the equipment had a triaxial accelerometer with a gyroscope that provided information on collisions and repeated high-intensity efforts. The most recently developed GPS equipment that has 10 Hz inertial sampling has been more used in team sports as they demonstrate lower error rates in the variables of total distance, sprint distance, metabolic load, and deceleration actions when compared to older 5 Hz GPS equipment. Previous evidence indicates the validity and reliability of 10 Hz GPS equipment to measure activities from sports circuits to linear races and even entire matches (Nikolaidis et al., 2018; Rampini et al., 2015; Scott et al., 2016).

Procedures

For data collection, a training match was performed, monitored, and analyzed. The head coach divided the two teams, aiming for equality in tactical, technical, and physical aspects. All athletes used the individual GPS, positioned in the dorsal region by a vest. The athletes were familiar with the equipment as they used it in their daily training. This vest was placed under the match shirt and adjusted to the athlete's body. The equipment was turned on 30 minutes before the match to ensure optimal signal quality, as oriented by the manufacturer's guidelines. In the Playertek Plus software® (also made available by Catapult Sports®) a session was created for the analyzed training match. During the match, the responsible researcher performed manual splits (time cuts performed through the Catapult software) of all live balls-in the game. After the match, splits were created to differentiate half-times and intervals using the same software. A separate file was created with all the data collected by the GPS during the match, containing information about the time splits and, therefore, the demands of the match on each BIP and period of the match. Data was downloaded with the Playertek Plus software® and the program itself generated a timeline differentiating the splits of the match. Subsequently, data were exported to Microsoft Excel® for statistical analysis and calculation of the average work demands for each BIP and for each half of the match. With this information, we also identified the longest-bout of BIP at the match and the specific demands of this period.

Statistical analysis

Physical demand variables were reported as mean, median, and standard deviation values. The distribution of all variables was accessed by Shapiro–Wilk's test. Whenever normal distributions were reported, we performed the comparisons using the Paired Samples T-test. Cohen's d was calculated as the effect size in this case, interpreting effects as small (0.2 to 0.49), medium (0.5 to 0.79), and large (above 0.8) (Cohen, 1988). On the other hand, when variables were not normally distributed we performed the comparisons using the Wilcoxon Signed-Rank test. In these cases, effect sizes were calculated as r, and interpreted as small (0.1 to 0.29), medium (0.3 to 0.49), and large (above 0.5) (Cohen, 1988). An alpha level of .05 was set for all statistical tests. All analyses were performed on Statistica software package version 12 (Statsoft, Tulsa, OK).

Results

The comparisons of the physical demands between ROLL and BIP methods in the first half of the match indicated more accelerations per minute in the BIP method ($t = -2.54$; $p = 0.035$) measurements. No differences were found for the other variables ($p > 0.06$), as seen in Table 1.

Table 1. Data and analyses for physical demands measured by ROLL and BIP methods in the first half.

	Mean ROLL 1st half	Median ROLL 1st half	Sd ROLL 1st half	CI ROLL 1st half	Mean BIP 1st half	Median BIP 1st half	Sd BIP 1st half	CI BIP 1st half	t	p	ES
Distance per min	88.82	91.05	10.62	83.46-94.18	118.82	116.41	38.68	95-142.65	-2.171	0.062	0.724
Sprint distance per min	15.08	13.54	7.50	11.29-18.87	23.94	17.56	22.65	9.99-37.89	-1.442	0.187	0.481
Accelerations per min	0.59	0.56	0.25	0.47-0.72	1.02	0.95	0.57	0.67-1.37	-2.54	0.035	0.847
Decelerations per min	0.88	0.90	0.45	0.65-1.11	1.62	1.78	0.82	1.11-2.12	-2.031	0.077	0.677

Note: Sd = Standard deviation; CI = Confidence interval; ES = Effect size.

On the other hand, comparisons of the physical demands between ROLL and BIP methods in the second half of the match indicated greater distance per minute ($t = -7.412$; $p < 0.001$), sprint distance per minute ($Z = 2.666$; $p = 0.008$), accelerations per minute ($t = -3.712$; $p = 0.006$), and decelerations per minute ($t = -5.289$; $p < 0.001$) for the BIP method measurements, as seen in Table 2.

Table 2. Data and analyses for physical demands measured by ROLL and BIP methods in the second half.

	Mean ROLL 2nd half	Median ROLL 2nd half	Sd ROLL 2nd half	CI ROLL 2nd half	Mean BIP 2nd half	Median BIP 2nd half	Sd BIP 2nd half	CI BIP 2nd half	t	p	Z	p	ES
Distance per min	77.65	77.86	10.35	72.43-82.88	121.24	125.72	20.73	108.48-134.01	-7.412	0.001	-	-	2.471
Sprint distance per min	9.38	8.50	6.34	6.18-12.58	24.92	19.53	20.21	12.47-37.37	-	-	2.666	0.008	0.889
Accelerations per min	0.49	0.53	0.31	0.33-0.65	1.12	0.91	0.41	0.87-1.38	-3.712	0.006	-	-	1.237
Decelerations per min	0.70	0.77	0.29	0.55-0.84	1.50	1.51	0.52	1.18-1.81	-5.289	0.001	-	-	1.763

Note: Sd = Standard deviation; CI = Confidence interval; ES = Effect size.

When physical demands for each of the half times of the match were compared using the ROLL method, analyses indicated that demands were higher in the first half of the match for distance ($t = 10.215$; $p < 0.001$), distance per minute ($t = 7.425$; $p < 0.001$), sprint distance ($t = 4.53$; $p < 0.001$), and sprint distance per minute ($t = 4.15$; $p < 0.001$) variables. No differences were reported for the other variables ($p > 0.05$), as seen in Table 3.

Table 3. Data and analyses for physical demands in the first and second halves measured by the ROLL method.

	Mean ROLL 1st half	Median ROLL 1st half	Sd ROLL 1st half	CI ROLL 1st half	Mean ROLL 2nd half	Median ROLL 2nd half	Sd ROLL 2nd half	CI ROLL 2nd half	t	p	ES
Distance	793.25	813.42	94.69	745.45-841.04	658.76	660.50	87.77	614.46-703.07	10.215	0.001	2.730
Distance per min	88.82	91.05	10.62	83.46-94.18	77.65	77.86	10.35	72.43-82.88	7.425	0.001	1.984
Sprint distance	134.68	120.95	67.00	100.86-168.5	79.54	72.10	53.79	52.39-106.7	4.53	0.001	1.211
Sprint distance per min	15.08	13.54	7.50	11.29-18.87	9.38	8.50	6.34	6.18-12.58	4.15	0.001	1.11
Accelerations	5.29	5.00	2.20	4.18-6.4	4.14	4.50	2.66	2.8-5.48	1.529	0.15	0.409
Accelerations per min	0.59	0.56	0.25	0.47-0.72	0.49	0.53	0.31	0.33-0.65	1.194	0.254	0.319
Decelerations	7.86	8.00	4.05	5.81-9.9	5.93	6.50	2.43	4.7-7.16	2.104	0.055	0.562
Decelerations per min	0.88	0.90	0.45	0.65-1.11	0.70	0.77	0.29	0.55-0.84	1.757	0.102	0.47

Note: Sd = Standard deviation; CI = Confidence interval; ES = Effect size.

On the other hand, when physical demands for each of the half times of the match were compared using the BIP method, analyses indicated that demands did not differ between half times for all variables ($p > 0.29$), as seen in Table 4.

Table 4. Data and analyses for physical demands in the first and second halves measured by the BIP method.

	Mean BIP 1st half	Median BIP 1st half	Sd BIP 1st half	CI BIP 1st half	Mean BIP 2nd half	Median BIP 2nd half	Sd BIP 2nd half	CI BIP 2nd half	t	p	Z	p	ES
Distance	61.09	43.26	55.79	23.73-95.45	48.66	41.82	18.42	37.31-60.01	-	-	0.415	0.678	0.138
Distance per min	118.82	116.41	38.68	95-142.65	121.24	125.72	20.73	108.48-134.01	-0.173	0.867	-	-	0.058
Sprint distance	14.77	6.44	19.55	2.73-26.81	8.66	10.74	4.40	5.95-11.37	-	-	0.296	0.767	0.099
Sprint distance per min	23.94	17.56	22.65	9.99-37.89	24.92	19.53	20.21	12.47-37.37	-	-	0.059	0.953	0.02
Accelerations	0.52	0.29	0.42	0.25-0.78	0.45	0.43	0.24	0.3-0.6	-	-	0.338	0.735	0.128
Accelerations per min	1.02	0.95	0.57	0.67-1.37	1.12	0.91	0.41	0.87-1.38	-0.441	0.671	-	-	0.148
Decelerations	0.83	0.64	0.73	0.39-1.28	0.62	0.64	0.31	0.43-0.81	1.123	0.294	-	-	0.374
Decelerations per min	1.62	1.78	0.82	1.11-2.12	1.50	1.51	0.52	1.18-1.82	0.384	0.711	-	-	0.128

Note: Sd = Standard deviation; CI = Confidence interval; ES = Effect size.

The analyses of the first half average physical demands and first half WCS physical demands, both measured through the BIP method, indicated greater distance ($Z = 2.666$; $p = 0.008$), sprint distance ($Z = 2.192$; $p = 0.028$), and decelerations ($t = -3.446$; $p = 0.009$) for first half WCS compared to the first half average physical demands, as seen in Table 5.

Table 5. Data and analyses for physical demands from the first half WSC and first half average measured by the BIP method.

	Mean BIP 1st half	Median BIP 1st half	Sd BIP 1st half	CI BIP 1st half	Mean WCS 1st half	Median WCS 1st half	Sd WCS 1st half	CI WCS 1st half	t	p	Z	p	ES
Distance	61.09	43.26	55.79	23.73-95.45	185.89	183.34	19.57	176.01-195.77	-	-	2.666	0.008	0.889
Distance per min	118.82	116.41	38.68	95-142.65	136.02	134.15	14.32	128.79-143.25	-1.324	0.222	-	-	0.442
Sprint distance	14.77	6.44	19.55	2.73-26.81	53.00	38.31	29.60	38.06-67.94	-	-	2.192	0.028	0.731
Sprint distance per min	23.94	17.56	22.65	9.99-37.89	38.78	28.03	21.66	27.85-49.72	-	-	1.007	0.314	0.336

Accelerations	0.52	0.29	0.42	0.25-0.78	1.21	1.00	1.12	0.65-1.78	-	-	1.54	0.123	0.545
Accelerations per min	1.02	0.95	0.57	0.67-1.37	0.89	0.73	0.82	0.47-1.3	-	-	0.56	0.575	0.198
Decelerations	0.83	0.64	0.73	0.39-1.28	2.43	3.00	1.60	1.62-3.24	-3.446	0.009	-	-	1.149
Decelerations per min	1.62	1.78	0.82	1.11-2.12	1.78	2.20	1.17	1.18-2.37	-0.772	0.462	-	-	0.257

Note: Sd = Standard deviation; CI = Confidence interval; ES = Effect size.

The analyses of the second half average physical demands and second half WCS physical demands, both measured through the BIP method, indicated greater distance ($t = -4.877$; $p < 0.001$) for second half WCS compared to the second half average physical demands. Additionally, fewer decelerations per minute ($Z = 2.31$; $p = 0.021$) were found for second half WCS compared to the second half average physical demands, as seen in Table 6.

Table 6. Data and analyses for physical demands from the second half WSC and second half average measured by the BIP method.

	Mean BIP 2nd half	Median BIP 2nd half	Sd BIP 2nd half	CI BIP 2nd half	Mean WCS 2nd half	Median WCS 2nd half	Sd WCS 2nd half	CI WCS 2nd half	t	p	Z	p	ES
Distance	48.66	41.82	18.42	37.31-60.01	83.30	85.33	17.19	74.62-91.98	-4.877	0.001	-	-	1.626
Distance per min	121.24	125.72	20.73	108.48-134.01	128.16	131.28	26.45	114.81-141.51	-0.822	0.435	-	-	0.274
Sprint distance	8.66	10.74	4.40	5.95-11.37	13.20	8.55	13.74	6.27-20.14	-	-	0.059	0.953	0.02
Sprint distance per min	24.92	19.53	20.21	12.47-37.37	20.31	13.16	21.14	9.64-30.89	-	-	0.652	0.515	0.217
Accelerations	0.45	0.43	0.24	0.3-0.6	0.57	0.00	0.76	0.19-0.95	-	-	0.28	0.779	0.099
Accelerations per min	1.12	0.91	0.41	0.87-1.38	0.88	0.00	1.16	0.29-1.47	-	-	0.77	0.441	0.257
Decelerations	0.62	0.64	0.31	0.43-0.81	0.57	1.00	0.51	0.31-0.83	-	-	0.56	0.575	0.198
Decelerations per min	1.50	1.51	0.52	1.18-1.82	0.88	1.54	0.79	0.48-1.28	-	-	2.31	0.021	0.770

Note: Sd = Standard deviation; CI = Confidence interval; ES = Effect size.

Discussion

This study investigated different methods for accessing professional female rugby players' physical demands in a single match. In this novel piece of research, we employed GPS performance metrics to identify the WCS demands through the analysis of the long-bouts of BIP during the match. The overall results showed that the ROLL method underestimated the workload averages when compared to the BIP method, that the BIP method was sensitive to workload changes across half times, and that WCS presented higher values of physical demands when compared to the match averages. These findings support previous research reporting the intermittent nature of rugby gameplay (Duthie et al., 2006; Quarrie et al., 2013; Roberts et al., 2008). Specifically considering the WCS, the majority of activity is carried out at low intensity with intermittent bursts of high-intensity collision and running activity. This is consistent with research on the rugby global demands, which reports that the high-intensity activity profile of players is more collision-based since they carry out more high-intensity running and sprinting (Austin et al., 2010; Duthie et al., 2006; Oliva-Lozano et al., 2022). Since the WCS is defined as the single longest period of continuous play in a game, this period of gameplay is likely characterized by a pattern of "phases". This type of structured game pattern would limit running distances and may account for the relatively low VO_2 max values observed, in addition to the lack of sprint efforts (Bortnik et al., 2022; Reardon et al., 2017). This, in turn, may be associated with the areas of the pitch in which contests for ball possession occur between competitions. Hypothetically, a more expansive running game played in the Pro12 would deliver more ball possession to the outside players and result in more collisions in those positions. Conversely, a more structured pattern with greater intensity of ball contests would result in more collisions in the middle of the field combined with lower HSR demands in playing positions.

Previous literature has reported that female Rugby Sevens players cover 1.060-1.099 m per match with 8.3-11.0% of distance covered at speeds above 18.0 km/h (Hogarth et al., 2016). Compared to players in the traditional rugby union format Rugby Sevens players cover more distance per minute and more distance per minute at high speeds (Higham et al., 2016 Quarrie et al., 2013). In addition, players competing at international level run greater distances at high speeds than players in domestic tournaments (Higham et al., 2016), suggesting that the ability to perform high-intensity running bouts is important in elite Rugby Sevens (Suarez-Arrones et al., 2014).

With the establishment of the WCS match demands using the GPS-Performance metrics, following the BIP categories (short, moderate, long, and very long), this study gives insight into the highest demands of match play at the Rugby Sevens professional level. These results allow more appropriate conditioning of athletes to ensure they can reproduce their peak performance in matches and minimize the risk of injury. Despite the relevance of this knowledge, there is a surprising lack of research in simulation protocols to replicate match demands, specifically in the case of the WCS match demands. The present study aims to build upon the existing body of research to contribute to the field of training, thereby ensuring that training meets the highest standards of quality, following the WCS of game demands.

As hypothesized, the mean and maximum BIP demands were significantly higher than the whole-game averages. Mean BIP metrics significantly differed between backs and forwards, primarily with high metabolic load distance (HMLD), HSR, and collisions. These metrics are shown to be high-intensity work as HMLD is the distance covered above the metabolic power value of 25.5W/kg. This metric is derived from Osgnach et al. (2010), as the distance covered while accelerating above $2m/s^2$ and sprinting over 5.5m/s (19.8km/h), along the metabolic power curve of 25.5W/kg. To present the average and maximum workload found, we categorized the BIP according to their durations, 0-30s, 31-60s, 61-90s, and >90s, as previously done by Pollard et al. (2018). West et al. (2021) further highlights the distinction between values derived from BIP and those obtained through whole-match analysis. These authors identified significant differences in the assessment of demands between all methods of analysis, including whole-match and mean/max BIP, for their selected metrics (m/min, HSR/min, accelerations/ min, decelerations/ min and HML/min). Another study conducted by Matthew et al. (2022) indicated that the metrics with the largest differences between whole-match averages and using the BIP method were HSR, accelerations, and decelerations. Interestingly, the high-speed running and acceleration meters (moderate and hard) metrics displayed the largest discrepancy values between the expected vs actual values from the Glasgow Rugby Intermittent (GRIT) simulation. These results illustrate both the difficulty and importance of the selected metrics.

In summary, WCS BIP demands offer a microscopic view of the conditioning requirements to reach and sometimes surpass match demands, as opposed to whole-match outputs. To elicit such higher demands, practitioners may delve deeper into other aspects not covered in the current literature or this study, e.g., in the form of inter/intra position competition (effect of social facilitation), pitch and simulation dimensions, and more refined acceleration zone marking. Nevertheless, the results suggest this needs to be re-examined to design a simulation where it is more feasible to achieve the WCS values.

Conclusion

The present study aimed to investigate different methods for analyzing physical demands and to determine the WCS demands through the analysis of the long-bouts of BIP at the match, to inform coaches and practitioners about the most demanding physical periods of Rugby Sevens match. Our results indicated that the ROLL method underestimated the workload averages when compared to the BIP method, that the BIP method was more sensitive to measuring workload changes across matches and half times, and that WCS presented higher physical demands compared to the match averages.

Therefore, we believe it would be beneficial for players to be conditioned considering the peak demands of the WCS, which can occur at any stage of the game. Future research should focus on achieving a valid method of quantification of collision and acceleration forces. This would greatly improve the interpretation of Rugby Sevens' demands both on average and in-bout basis.

Conflicts of interest - The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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