2024, Retos, 59, 560-567

Relationship between different technical, physical and anthropometric characteristics in female rugby sevens players
La relación entre diferentes características técnicas, físicas y antropométricas en jugadoras de rugby siete femenino

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Abstract. This study aimed to identify relationships between technical, physical, and anthropometric characteristics in 31 female rugby sevens players. During 28 weeks, the athletes performed 37 friendly matches to assess technical variables (e.g. effective passes), 6 assessments of athletic performance (strength, power and running tests), and 4 evaluations of anthropometric measures (height, body mass, circumferences, lean and fat mass). Pearson's and Spearman's coefficients estimated the correlations between technical parameters and the correlations between physical and anthropometric variables. Correlations were verified between technical and physical or anthropometric variables ($p \leq 0.05$). Moderate to almost perfect correlations were found between technical variables ($r = 0.36$-0.99) and moderate to large correlations between physical and anthropometric parameters (r ranging from 0.36 to 0.68). Standing long jump was associated with 35.4% of duel and 30.5% of effective duel, pull-up strength was associated with 12.7% of duel, and 1,200-m was associated with 12.6% of effective pass and 26.2% of tackle. Tackle was associated with abdominal (14.1%), waist (13.7%) and hip (15.6%) circumferences, and fat mass (13%). Therefore, anthropometric and physical parameters may influence the tackles, duels and effective passes performed in the rugby sevens.
Keywords: team sports; physical performance; women.

Resumen. Este estudio tuvo como objetivo identificar las relaciones entre las características técnicas, físicas y antropométricas en 31 jugadoras de rugby seven. Durante 28 semanas, las atletas realizaron 37 partidos amistosos para evaluar variables técnicas (por ejemplo, pases efectivos), 6 evaluaciones de rendimiento atlético (pruebas de fuerza, potencia y carrera) y 4 evaluaciones de medidas antropométricas (altura, masa corporal, circunferencias, masa magra y grasa). Los coeficientes de Pearson y Spearman estimaron las correlaciones entre los parámetros técnicos y las correlaciones entre las variables físicas y antropométricas. Se verificaron correlaciones entre variables técnicas y físicas o antropométricas ($p \leq 0,05$). Se encontraron correlaciones moderadas a casi perfectas entre variables técnicas ($r = 0,36$-$0,99$) y correlaciones moderadas a grandes entre parámetros físicos y antropométricos (r que oscila entre 0,36 y 0,68). El salto de longitud en posición estática estaban asociado con el 35,4% de los duelos y el 30,5% de los duelos efectivos, la fuerza en la barra fija se asoció con el 12,7% de los duelos, y los 1.200 metros estaban asociados con el 12,6% de los pases efectivos y el 26,2% de los placajes. El placaje se asoció con circunferencias abdominales (14,1%), de cintura (13,7%) y de cadera (15,6%), y masa grasa (13%). Por lo tanto, los parámetros antropométricos y físicos pueden influir en los placajes, duelos y pases efectivos realizados en el rugby seven.
Palabras clave: deportes de equipo, rendimiento físico, mujeres.

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Introduction

Rugby sevens involve physical, technical, and tactical skills and require intermittent high-intensity runs and relatively long distances (Henderson et al., 2018). The game's physical characteristics require effort from 1:0.3 to 0.4 for work:rest ratio in women (Ball et al., 2019). In addition, high running speed, repeated power application and greater conditioning levels are important physical parameters to performance in the game (Schuster et al., 2018). Female rugby sevens athletes increasingly need the combination of physical conditioning and specific technical attributes to succeed in the game (Clarke et al., 2017). However, a previous study observed that related individual factors may be associated with part of the physical and technical performance in elite athletes (Henderson et al., 2019).

The movement demands in rugby sevens are increased according to the higher-level competition because the teams' tactical advance is providing more offensive space and greater physical demands involved in the game (Ball et al., 2019). Considering the energetic contribution in the match, both aerobic and anaerobic capacities should be developed simultaneously (Henderson et al., 2019). Therefore, high-speed running is essential in rugby sevens due to the open style of play with large displacement spaces (Blair et al., 2017).

Offensive technical performance in rugby sevens necessity to create opportunities of advancing, as breaking lines and the ball retention (Ross et al., 2016 & Higham et al., 2014), while defensively, the players need to perform effective tackles to match success (Ross et al., 2016 & Reyneke et al., 2018). Nevertheless, understanding individual factors that influence sport performance is still scarce in the literature, considering the relationships between the physical profile and sport-specific skills (Henderson et al., 2018).

Therefore, this study aimed to examine the relationships between anthropometric, physical, and technical variables in female rugby sevens players. The difference of physical performance between competition level (Ball et al., 2019 & Sella et al., 2019), but the similarity on anthropometric and physical parameters in rugby sevens (Agar-Newman et al., 2017), and the importance of strength and power capacity to perform effective technical actions (Clark et al., 2017 & Ross et al., 2016), suggest the hypothesis that: (a) the athlete profile indicates that rugby sevens players with lower body fat percentages and circumferences may show better running abilities and less strength; (b) power and running conditioning may be associated with offensive and defensive actions related to important decisions.

Materials and methods

Experimental approach to the problem

A professional rugby team followed during the 2020 season was evaluated to identify correlations between anthropometric, physical fitness variables, and passes, tackles, duels, rucks, tries, and positive and negative actions during the rugby matches. Due to the coronavirus pandemic, all evaluations were performed during a non-competitive season, in the 28-week period. The technical parameters were assessed through 37 friendly matches analysis, carried out weekly on Saturdays. The athletes participated in 1 to 2 analyzed matches per Saturday, randomly distributed into 2 teams per game. During the period, each participant obtained, at most, 2 non-consecutive rest Saturdays. There were 4 anthropometric assessments for each measurement and 6 physical evaluations for each test. Considering the 6 anthropometric evaluations carried out during the season, the mean result was obtained for data analysis. As for physical fitness, the best performance among the 4 evaluations carried out during the season was considered for data analysis. The running tests were carried out on a natural grass field, and the athletes were wearing rugby boots. The tests' order was as follows: linear sprint, pro-agility, standing long jump, 1RM bench press, 1RM pull-up, and 1200-m running time. The participants were previously familiarized with the tests, and 15-min standardized warm-ups including core exercises (4 sets of 30 s front and side planks with 30 s passive intervals), mobility (15 repetitions of overhead squat and internal and external rotation at the maximum range of ankles, hips, torso, shoulders, and neck), and muscle activation (3 sets of 10 s stationary running, 5-m lateral movement to both sides, and 1 sprint of 10-m) were carried out before the matches and the physical tests. From the different moments of the assessments carried out in the 28 weeks, the average of individual anthropometric measures and the best performance of the physical tests was used to analyze this study.

Subjects

Thirty-one professional Brazilian female rugby players (25.74 ± 5.25 years; 63.64 ± 10.43 kg; 1.65 ± 0.06 m) participated in this study. The participants composed the same professional rugby club. They used to participate in a systematic physical and tactical-technical training routine of 5-day per week with 2 sessions of approximately 90 minutes a day. This study was approved by the Research Ethics Committee of the Federal University of Pelotas (see number 4.658.874), and all participants read and signed the informed consent form.

Procedures

Anthropometric measures. The participants carried out the following measurements: height, body mass, circumferences of the abdomen, waist and hips, fat mass percentage, absolute fat and lean mass. A wall stadiometer was used to measure height to the nearest 0.01 m (Standard Stadiometer, Sanny, Brazil), with bare feet. An electronic scale was used to measure body mass with to the nearest 0.01 kg (Soehnle Professional, Frankfurt, Germany). An anthropometric measuring tape (CESCORF, Brazil) was used to measure the circumferences of the abdomen, waist and hips. The evaluation of 7 skinfolds was conducted following all the previous recommendations (Norton et al., 1996), to obtain the percentage of fat through the equation of Jackson et al. (1980).

Linear sprint. From a standing position, the athletes performed a 30-m linear sprint in the shortest time possible. The instructors encouraged the athletes to run 32 meters to prevent them from slowing down before reaching 30m. Sprint time was recorded using the MySprint app (Apple Inc., USA) (Romero-Franco et al., 2017). Participants performed 2 attempts with a 3-minute rest interval, and the fastest time was registered.

Pro-agility test. The participants started the test in a standing position on the starting line, facing the photocell. Then, they performed a 5-m linear sprint to the right side to touch the line, changed 180° direction and 10-m sprint to touch the other line, and again they changed 180° direction followed by a 5-m sprint to reach the starting point (Stewart et al., 2014). A photocell (CRONO HD, Cardiomed, Brazil) registered the time of the athlete's performance. The participants carried out 2 attempts, with a 3-minute rest interval, and the fastest time was registered.

Standing long jump. The athletes started the tests standing up and immediately behind the start line. The jump was performed with the upper limbs' contribution, and they performed maximum thrust to reach the greatest possible distance (Markovic et al., 2004). They carried out 2 attempts with a 3-minute rest interval, and the greatest distance reached between the start line and the point of the heel closest to the start line was registered.

One-repetition-maximum (1RM) tests. The 1RM tests were assessed by the following exercises: bench press, and a pull-up. The strength tests were carried out indoors and on a rubberized floor. Olympic barbells (Fortify, Brazil) were used to evaluate 1RM in the bench press. The pull-up 1RM test was performed on a specific pull-up bar (Fortify, Brazil). The athletes made up to 4 attempts for each test, and a 5-minute rest was conducted between each attempt. The pull-up was carried out with the neutral-grip, and a valid repetition consisted of flexing the elbows until the athlete could

2024, Retos, 59, 560-567

bring her chin above the pull-up bar (McGuigan et al., 2010). A belt around the midsection secured additional loads, and the additional load was added to the body mass to record 1RM.

1,200-m running time. On the natural grass field, the athletes performed the 1,200-m running test. The participants were encouraged to complete the route in the shortest possible time. The evaluators recorded the total running time in minutes for analysis.

Technical parameters. Friendly rugby sevens matches were analyzed for individual technical variables' effectiveness: pass, tackle, duel, ruck, try, and positive, negative and total actions. Pass, tackle, duel, and ruck were evaluated for the effectiveness of the action, classifying them in a dichotomous manner. The definition of the analyzed variables is described in figure 1. The athletes were randomized in the 37 matches, recorded with a drone (DJI, Mavic 2 Pro, China), and an experienced evaluator performed the video analysis using technical scouting. Each variable's actions were accumulated, and the variable was registered in the number of relative actions per game. The analysis of the intraclass correlation coefficient (ICC) identified an intra-rater reliability above 0.99 for all technical actions included in the video analysis.

Variable	Definition
Pass	The action of passing the ball to the teammate, regardless of effectiveness.
Effective pass	Pass the height between the hip and shoulders line, in front of the receiver (future point), not requiring the receiver to slow down or have to adapt his running line abruptly to receive the ball.
Tackle	The action to prevent the ball carrier from advancing by taking him to the ground, regardless of effectiveness.
Effective tackle	Actions that brought the ball carrier to the ground, preventing the opponent from advancing.
Duel	Offensive actions in which a defender got close enough to the attacker so that one or more direct actions were required to continue advancing or continuing the game.
Effective duel	Actions that enabled the attacker to continue advancing; that it required more than one defender to contain the attacker; that the attacker had the possibility to make a pass or off-load; that the attacker controls the contact securely, and can easily make the ball available during the presentation; or that the attacker avoids losing possession in an adverse situation (duel close to the flank; after receiving an ineffective pass; when recovering a ball close to his in-goal).
Ruck	Ball dispute actions after the presentation of the ball carrier and creation of the offside line.
Effective ruck	Attack: actions that the player's entry in the ruck was decisive for maintaining the ball's possession. Defense: Entry into a ruck that would result in the ball possession or delay the ball's departure by more than 3 seconds.
Try	Act to touch the ball in the opponent's in-goal to obtain a 5-point score.
Positive actions	Sum of all effective actions performed by the athlete during a game. The actions taken into account were effective passes, effective tackles, effective duels, effective rucks, effective presentations, effective aerial receptions, effective kicks, loaded, recovered balls, assists, pass receptions, chesting, and tries.
Negative actions	Sum of all ineffective actions performed by the athlete during a game. The actions taken into account were ineffective passes, ineffective and punctured tackles, ineffective duels, ineffective rucks, ineffective presentations, ineffective aerial receptions, ineffective kicks, and missed balls.
Total actions	Sum of positive and negative actions.

Figure 1. Definitions of technical variables

Statistical analyses

Data were presented as mean ± standard deviation (SD), and confidence limits of 95%. The Shapiro Wilk test identified 17 parametric variables (pass, effective pass, tackle, duel, effect duel, ruck, effective ruck, positive actions, negative actions, total actions, pro-agility test, 30-m sprint time, 30-m sprint speed, 1RM pull-up, height, and fat percentage) and 11 non-parametric variables (effective tackle, try, standing long jump, 1RM bench press, 1200-m running time, body mass, abdominal circumference, waist circumference, hip circumference, fat mass, and lean mass). Pearson's correlation (r) was used to verify relationships between variables when at least one was parametric, and Spearman's correlation (ρ) was used to verify relationships between nonparametric variables. The correlation coefficients were considered to be trivial (<0.09), small (0.1–0.29), moderate (0.3–0.49), large (0.5–0.69), very large (0.7–0.89), or nearly perfect (>0.9), following previous recommendations (Hopkins et al., 2009). Finally, the correlation data were presented in matrix and scatter plots. The significance level was set as $p \leq 0.05$.

Results

The sample presented 21.65 ± 11.27 of matches played. Table 1 shows the descriptive data of anthropometric, physical and technical variables.

Table 1.
Descriptive of the anthropometric, physical, and technical variables presented with the female professional rugby players (n = 31)

Variables	Mean ± SD	IC95%
Age (years)	25.74 ± 5.25	24.14 – 27.34
Body Mass (kg)	63.64 ± 10.43	60.46 – 66.82
Height (m)	1.65 ± 0.06	1.63 – 1.66
Abdominal circumference (cm)	75.93 ± 7.84	73.54 – 78.32
Waist circumference (cm)	71.29 ± 6.18	69.41 – 73.18
Hip circumference (cm)	96.34 ± 6.67	94.32 – 98.37
Fat percentage (%)	20.06 ± 4.38	18.73 – 21.40
Fat mass (kg)	13.12 ± 5.09	11.57 – 14.67
Lean mass (kg)	50.48 ± 5.99	48.65 – 52.30
Pro-agility test (s)	5.82 ± 0.21	5.75 – 5.88
Standing long jump (m)	2.15 ± 0.15	2.10 – 2.20
30-m sprint time (s)	5.15 ± 0.23	5.08 – 5.22
30-m sprint speed (m·s-1)	5.84 ± 0.27	5.76 – 5.91
1RM bench press (kg)	58.64 ± 8.59	56.02 – 61.26
1RM pull-up (kg)	80.34 ± 10.72	77.08 – 83.61
1,200m running time (min)	5.37 ± 0.69	5.16 – 5.59
Pass (n)	3.92 ± 1.83	3.36 – 4.48
Effective pass (n)	2.90 ± 1.39	2.47 – 3.32
Tackle (n)	2.98 ± 0.82	2.73 – 3.24
Effective tackle (n)	2.08 ± 0.82	1.83 – 2.33
Duel (n)	2.41 ± 1.02	2.09 – 2.72
Effective duel (n)	2.15 ± 1.02	1.84 – 2.47
Ruck (n)	1.05 ± 0.50	0.89 – 1.19
Effective ruck (n)	0.87 ± 0.43	0.74 – 1.01
Try (n)	0.28 ± 0.23	0.21 – 0.35
Positive actions (n)	13.76 ± 3.05	12.83 – 14.69
Negative actions (n)	4.29 ± 1.12	3.95 – 4.64
Total actions (n)	18.29 ± 3.91	16.86 – 19.24

Table 2.
Correlation coefficients between technical variables analyzed in female professional rugby players (n = 31)

	EP	TA	ET	DU	ED	RU	ER	TR	PAC	NA	TTA
PA	0.96**	0.01	0.05	-0.37*	-0.34	0.47**	0.48**	-0.24	0.72**	0.71**	0.76**
EP		0.04	0.05	-0.38*	-0.35	0.35	0.37*	-0.18	0.70**	0.71**	0.75**
TA			0.84**	0.20	0.17	0.37*	0.36*	0.33	0.38*	0.22	0.36*
ET				0.15	0.15	0.37*	0.35	0.36*#	0.35	-0.00	0.27
DU					0.99**	0.08	0.04	0.38*	0.27	-0.09	0.18
ED						0.11	0.06	0.35	0.28	-0.10	0.19
RU							0.97**	-0.08	0.51**	0.35	0.50**
ER								-0.10	0.52**	0.34	0.50**
TR									0.18	-0.02	0.14
PAC										0.70**	0.98**
NA											0.83**

*p ≤ 0.05; **p ≤ 0.01; #Spearman correlation coefficient (ρ). PA = pass, EP = effective pass, TA = tackle, ET = effective tackle, DU = duel, ED = effective duel, RU = ruck, ER = effective ruck, TR = try, PAC = positive actions, NA = negative actions, TTA = total actions

Table 2 shows the correlation coefficients between the technical variables. Passes, duels and rucks showed a nearly perfect correlation with their respective effective action ($p < 0.001$), but tackle presented a very large correlation with effective tackle ($p = 0.001$). This result shows that tackles are actions prone to obtain more errors than passes, duels and rucks. Passes followed by rucks are the variables most correlated with positive actions ($p < 0.004$). However, both pass and effective pass were strongly correlated with negative and total actions ($p < 0.01$). A moderate correlation indicated that athletes who performed more duels and effective tackles were more likely to perform more tries ($p \leq 0.044$).

Table 3 shows the correlations between anthropometric and physical variables. Moderate and large correlations were observed with running tests, indicating slower athletes have an anthropometric profile with a higher fat rate and body size. A moderate correlation also showed that athletes presented a higher standing long jump with lower hip circumference ($p = 0.018$) and fat percentage ($p = 0.046$). Except for height, anthropometric measures were moderate to large positive correlated with the 1RM tests, demonstrating the important relationship of the anthropometric profile with the strength.

Table 3.
Coefficients correlation between a physical test and an anthropometric measure in female professional rugby athletes (n =31)

	BM	HT	AC	WC	HC	%FM	LM	FM
Pro-agility test (s)	0.43*	0.23	0.36*	0.33	0.48**	0.50**	0.35	0.48**
Standing long jump (m)	-0.20#	0.11	-0.32#	-0.23#	-0.39*#	-0.41*	-0.09#	-0.33#
30-m sprint time (s)	0.19	-0.08	0.35	0.29	0.20	0.33	0.10	0.28
30-m sprint speed (m·s-1)	-0.21	0.05	-0.36*	-0.30	-0.22	-0.34	-0.12	-0.29
1RM pull-up (kg)	0.68**	0.30	0.66**	0.64**	0.60**	0.46**	0.68**	0.59**
1RM bench press (kg)	0.47**#	0.19	0.45*#	0.46**#	0.41*#	0.62**	0.43*#	0.52**#
1,200-m running time (min)	0.36*#	0.02	0.43*#	0.47*#	0.37*#	0.68*	0.24#	0.48*#

*p ≤ 0.05; **p ≤ 0.01; #Spearman correlation coefficient (ρ). BM = body mass, HT = height, AC = abdominal circumference, WC = waist circumference, HC = hip circumference, %FM = fat mass percentage, LM = lean mass, FM = fat mass

Figure 2 shows the correlations between these parametric technical variables with physical fitness variables. Standing long jump presented large correlations with duels and tries ($p \leq 0.001$). The 1,200-m running time revealed moderate and positive correlation with the effective pass ($p = 0.054$), large and negative correlations with tackle ($p = 0.004$) and moderate and negative correlation with effective tackle ($p = 0.033$). Duel correlated moderately with 1RM pull-up ($p = 0.049$), and try obtained a moderate correlation with 1RM bench press ($p = 0.049$). Figure 3 shows the correlation between tackle and anthropometric characteristics. The tackle was correlated moderately and negatively with circumference variables ($p < 0.05$) and fat mass ($p = 0.046$).

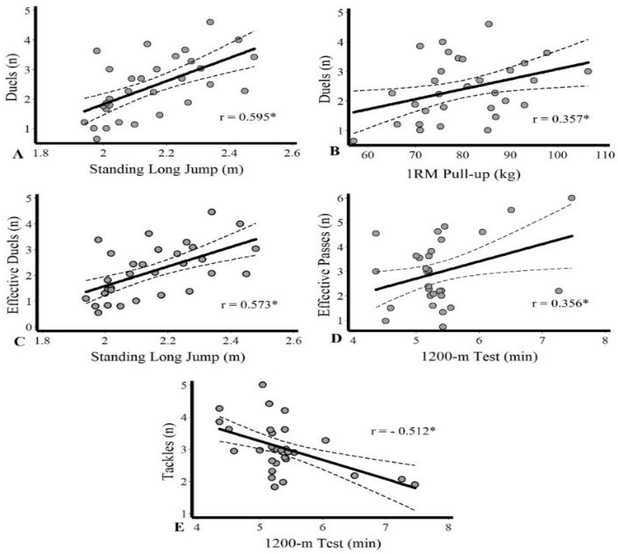

Figure 2. Scatter plot of correlations between technical and physical fitness variables. *p ≤ 0.05

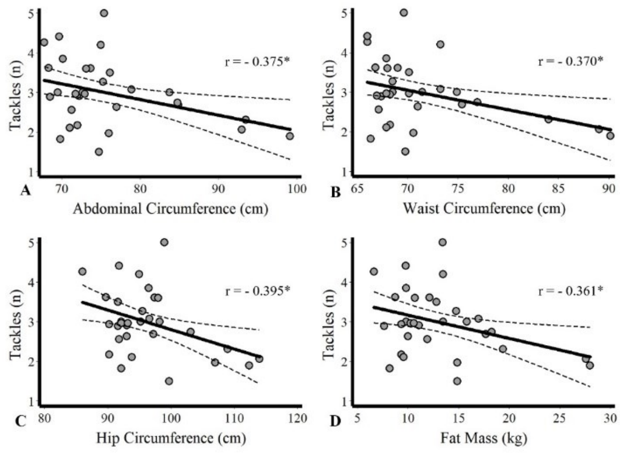

Figure 3. Scatter plot of correlations between tackle and anthropometric characteristics. *p < 0.05

Discussion

This study investigated the relationships between technical, physical fitness, and anthropometric variables in female professional rugby players evaluated during a 7-month period. The main results revealed that: a) athletes who perform more tackles in the game have smaller circumferences and fat mass, as well as better performance in the 1200-m test; b) duels were associated 35.4% for jumping performance and 12.7% for 1RM pull-up; c) slower athletes on the 1,200-m running time perform effective passes. To our knowledge, this is the first study to investigate these influences on technical parameters on women's professional rugby friendly matches. These findings suggest that athletes' profile related to physical fitness and anthropometry may influence rugby's technical performance.

Tackle is a collision action whose objective is to prevent the ball carrier from advancing to subsequently regain possession of the ball (Hendricks et al., 2020). Consistent literature shows the importance of tackling effectiveness in a rugby match's success (Sewry et al., 2015; Vaz et al., 2010; Ungureanu et al., 2019 & Ortega et al., 2009). Authors identified that winning teams perform and complete more tackles (Vaz et al., 2010 & Ortega et al., 2009). Previous results also have identified that winning teams perform 3% more effective tackles and 4% less ineffective tackles (Van Rooyen et al., 2014). In rugby sevens, women elite athletes had a moderately greater number of missed tackles in low-scoring (<21) games compared to high-scoring (≥21) games (low = 0.5 ± 0.6 tackles; high = 0.4 ± 0.7 tackles) (Reyneke et al., 2018). Also, rugby league players presented a correlation between vertical jump and tackle ability (r = 0.38), and acceleration may influence 24% (r = 0.60) the tackle ability (Gabbett et al., 2010). In addition, under fatigue conditions, athletes with greater aerobic fitness had better tackle ability (Gabbett et al., 2016). Another study identified a large correlation (r = 0.50) between standing long jump and tackle score in male rugby sevens players (Ross et al., 2015). In the current study, we identified an important relationship between the anthropometric profile and aerobic fitness with the number of tackles per game of rugby sevens. Unlike previous findings (Gabbett et al., 2010 & Ross et al., 2015), this study did not identify relationships between lower limb power and tackle, probably because the demand for female rugby sevens requires greater defensive displacements [1] due to the lower number of players (Ross et al., 2016), and the lower running capacities in females compared to males (Clark et al., 2017). Therefore, in agreement with a previous study (Gabbett et al., 2016, lighter athletes with greater running capacity can benefit from performing tackles.

Dueling is offensive situations of 1 vs. 1 that generate opportunities for breaking defensive lines and possibilities to move forward. Previous results indicate that rugby union success requires skills to break the tackle, from the attacker's ability to receive the ball at high speed in 1 vs. 1 duel (Ross et al., 2016 & Wheeler et al., 2010). Also, the authors noted that winners break lines more often and recover more balls than losers (Ortega et al., 2009). Ross et al. (2015), found moderate correlations between 5 and 10m acceleration with lines broken (r of -0.35 and -0.47, respectively) in rugby sevens players. This indicates that the acceleration can influence duels' success in defensive line breaks. Our results demonstrated that athletes perform more tries when they carry out more duels, and the distance in standing long jump predicts 35.4% e 30.5% duels and effective duels, respectively. Whereas the acceleration capacity is largely associated with jumping power in rugby players (Loturco et al., 2022), this study corroborates with the previous findings because female rugby sevens athletes have shown lower limb power is essential for creating opportunities to advance on the playing field.

The ruck characterizes the transition of the game phases through the dispute of the ball on the ground between two players on their feet. Vaz et al. (2010), identified that losing teams make more rucks and passes. In international rugby sevens matches, about a third of tackles resulted in a ruck (Hendricks et al., 2020). Rugby sevens players require various running skills, collisions, and continuity, considering that keeping possession of the ball and avoiding contacts in rucks and mauls can influence the match's success (Henderson et al., 2018). The current study identified that rucks were strongly correlated with positive actions and moderately correlated with passes and tackles. However, no relationship was observed between the ruck and anthropometric or physical variables. In rugby sevens, the dispute for rucks commonly occurs between one player from each team, promoting faster decision making and effective techniques to avoid losing possession of the ball (Barkell et al., 2017). Therefore, although the ruck is an important action for maintaining or recovering possession of the ball, technical and tactical characteristics may be more determinant for this action's effectiveness than physical and anthropometric variables. This implies that coaches must adopt collective strategies to benefit their teams during the ruck, especially in fatigue conditions (Barkell et al., 2017).

Authors have identified small differences in the total passes per minute between provincial and international rugby sevens athletes (Ross et al., 2015). In the 15-a-side rugby union, losing teams usually carry out more passes (Vaz et al., 2010). In contrast, international female rugby sevens athletes did not show any difference between games with less (passes = 5.0 ± 4.2) or equal/greater (passes = 5.1 ± 2.9) scoring differentials than 21 (Reyneke et al., 2018). We found that athletes who pass more balls perform moderately fewer duels, and slower athletes in 1,200-m running times perform moderately more effective passes. These findings indicate that passes can be used more by athletes with specific tactical functions that participate in the game's continuity and possibly provide assistance for sprinters and evasive athletes. Reyneke et al. (2018) identified a greater number of passes than in the current study, probably because athletes from international competitions need to perform more actions in less time than national level athletes (Sella et al., 2019), in addition to having a better technique for making passes.

The excellence in rugby sevens requires high levels of conditioning, running speed and the ability of power output (Schuster et al., 2018). Our results demonstrated that the 1,200-m running performance is associated with tackles and passes technical actions, and it is also related to body size and accumulation of fat. Due to the little variation in body size among rugby sevens athletes (Agar-Newman et al., 2017), heavier athletes probably are not big enough to duel and break lines as in 15-a-side rugby union (Hill et al., 2018). Another explanation refers to the similar distances covered between positions, these athletes being involved in fixed formations, reaching lower maximum running speeds (Misseldine et al., 2021).

2024, Retos, 59, 560-567

The running speed is essential for rugby sevens athletes to perform evasions and go forward to the opponent in-goal. Male athletes showed correlation between 40-m sprint and line breaks (r = -0.51) and tackle scores (r = -0.46) (Ross et al., 2015). On the other hand, our results did not indicate relationships between technical actions and 30-m sprint variables. Different from the previous study, our results demonstrate that sprint actions are not associated with technical variables. However, the competitive level and the method of technical evaluation may explain the disagreement between the studies (Higham et al., 2014).

Among the physical skills of rugby athletes, the high change of direction speed (CODS) benefits the offensive actions such as breaking the defensive line, decision making in duels, and evasions. Different CODS tests present large to very large associations with 10-m and 20-m linear speed tests in Olympic team-sport athletes (Pereira et al., 2018). In the current study, the athletes showed moderate to large correlations between the pro-agility test and anthropometric variables but not a correlation with technical actions. In rugby league athletes, the CODS test was moderately correlated with the sum of skinfolds (Gabbett et al., 2016). Therefore, it is understood that CODS ability can be improved with the modification of anthropometric values, and, despite not being related to technical variables analyzed in this study, CODS has an essential role in conquering the adversary territory (Müller et al., 2021).

Summary, we show in the present study that variables related to body size, strength, power and running capacity can influence technical performance. Therefore, training programs should offer the development of sport-specific physical abilities for all athletes. In this study, the analysis of unofficial games played in the championship is a limitation, because it can differentiate technical performance in a competitive situation. However, the 28-week season follow-up period strengthens the study's findings, attenuating unrepresentative conclusions.

Conclusions

Power of lower limbs, aerobic fitness, pull-up strength, fat mass, and circumferences may influence the rugby sevens game's technical actions. Although there are no statistical differences between rugby sevens' positions, the anthropometric profile was associated with the number of tackles, suggesting that athletes with larger measures and fatter occupy more central positions with fewer collisions. Still, athletes who duel more also perform more tries. Athletes who ran 1,200-m in less time presented lower anthropometric measurements and performed more tackles and fewer effective passes per game. In contrast, passes are also related to negative actions, suggesting that this action is frequent during the game and can be risky. Female rugby players have well-defined parameters about physical fitness related to anthropometric characteristics. Stronger players are heavier and have more fat and circumferences, while lighter and leaner athletes have better performance in the change of direction speed and running in 1,200-m. These results demonstrated that anthropometric and physical fitness characteristics of Brazilian professional athletes may be associated with technical variables during a rugby sevens match.

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