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Original Article

Anthropometric profile and physical fitness performance comparison by game position and connections with performance parameters in official matches of Chilean men rugby players

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Abstract:
Objective: the objective of this study is to describe and compare the anthropometric profile and physical condition of the players' positions and analyze their possible associations with sports performance in a season of official matches of amateur rugby players. According to the studies cited, the Backs is hypothesized to be different physically and anthropometrically than the Forwards. **Material and Methods**: This study has an experimental, observational, descriptive, comparative, and correlational design. The link between physical tests and anthropometric variables with sport performance parameters of a season in amateur Chilean rugby players was investigated and compared according to the playing position. In this study, thirty-five Chilean amateur male rugby players were evaluated (± average SD, age, 23.8 ± 4.8 years). All subjects played in the same team. They were divided into 16 Backs and 19 Forwards. The statistical test of independent samples was applied to establish the differences between the playing positions. Correlations were calculated using the person for normal data and Spearman for non-parametric variables. **Results**: For weight, the Backs group has 17.7% lower body weight than the Forwards group. About the height, size of less than 1.3% is observed for the Backs. In physical parameters, the data show the differences in 1RM DS ($p = 0.033$) and VO2 max ($p = 0.015$) between the Bk and Fw. For the relationship, this study finds the relations of Weight (R2= 0.229) and ∑6 Folds (R2= 0.20) with HSR, showing statistical significance ($p< 0.01$). **Conclusions**: In conclusion, we can report differences in anthropometric and physical profiles between the Bk and the Fw in Chilean amateur Rugby. This study also noted that anthropometric measures of Weight and ∑6 Folds are moderately associated with the performance of accelerations in an official Rugby season.
Key Words*:* **Rugby – Anthpometry – Exercise Test - GPS**

Introduction

Rugby is a collision sport characterized by high physical demand when play (Ball et al., 2018), where high-intensity runs, walks, low-speed jogs (Roberts et al., 2008). Characterized by high frequency of physical contact during the game (Junaidi et al, 2021). Depending on their position, players can travel between 8.5 to 10 kilometers, with a ratio of work and recovery between 1:7 to 1:28 per match (Pasin et al., 2017). Previous research has shown that the sporting event in Rugby is related to the need to repeatedly perform accelerations, decelerations, changes of direction, high-speed sprints, and tackles (Twist et al., 2014). For all of these, Rugby players must develop the components of strength, power, speed, and aerobic capacity (Dempsey et al., 2018).

Several studies have evaluated the relationship between physical testing and performance in high-intensity sports (Carlo et al., 2010). During field tests, Castagna et al., (2009) and Krustrup et al., (2003) found that the players with the best performance in the Yo-Yo test had higher performances on GPS variables during collective sports. In Rugby, a significant connection has been found between Rugby players' performance at the maximum aerobic speed and the distance covered during the game (Swaby et al., 2016). Regarding strength, several studies show a direct relationship between strength and running speed in various intermittent sports (Chelly et al., 2009; Stølen et al., 2005). In Rugby, it has been observed that changes in the strength of a maximum squat repetition can cause increased performance in races of 5 meters, 10 meters, and 20 meters (Comfort et al., 2012). In addition, Harris et al., (2008) found a small to moderate correlation (r= -0.29 and r= -0.33) between strength gains related to muscle mass and running time in 30 and 40 meters in rugby players. A study by Smart et al., (2014) proposes that a better jump height, agility, and speed in 20 and 40 meters are associated with an increase in the ability to beat the opponent. Other research has determined that physical racing abilities in Rugby players are associated with better performance in collisions (Gabbett et al., 2013). In that same line, the investigation of Pasco et al., (2019) show the existence of a correlation between speed skills

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and tactical elements. In Rugby, collisions are a crucial component of the game. The defensive tackle can prove fundamental to determining the outcome of an official Rugby match (Takarada, 2003). There is evidence that has shown that the players with the best ability to develop high speeds and high levels of speed are the ones who will manage to dominate in a tackle situation (Baker & Newton, 2008). Rugby is played with 15 players who are on the field simultaneously and can be grouped into two positions Forward (Fw) and Backs (Bk) (Sheehan et al., 2022). Previous studies have described differences in the physical and anthropometric performance profiles between positions (Comfort et al., 2011; Quarrie et al., 1996). In relation to the game's characteristics, both positions have differences in the physical, technical, and tactical demands during an official match (Jones et al., 2013.; Sheehan et al., 2022; Twist et al., 2014). The Bk stands out as players who travel greater distances at a higher intensity of play during a match (Zúñiga-Vergara & Castro, 2021) Fw are players who perform the most significant number of contact plays (Takarada, 2003) and have the highest strength values (Baker & Newton, 2008; Takarada, 2003).

Anthropometry allows the evaluation of morphological characteristics by taking measurements of the body and research has been done on the anthropometric characteristics of Rugby players (Gabbette al., 2000a). In conjunction with the players' fitness, this characteristic could increase their athletic performance (Baker & Newton, 2008). The height and weight of Rugby players are two of the physical characteristics that have increased with the development of international Rugby (Brazier et al., 2020). Also, Gabbett et al., (2009) found that elite players have greater muscle mass than lower category players. In the same line, some studies have associated that player with better body composition are associated with the ability to perform longer sprint (ranged r= 0,61 and 0,73) and better performance in strength test (ranged r= 0,24 and 0,65) (Hamlin et al., 2021). The evidence suggests that rugby athletes require relatively high levels of functional body mass with low % body fat (Brazier et al., 2020). In amateur players, body weight differences have been reported, with Fw being heavier than Bk (Gabbett et al., 2000b). Research seems to indicate that, for amateur players, anthropometric characteristics are not sufficiently developed (Gabbett et al., 2000c).

Finally, success in Rugby seems to be tied to a large extent to players possessing an integral development of anthropometric components and physical qualities, determined mainly by endurance, agility, speed, and strength (Meir et al., 2001). However, it is currently unclear whether previous levels of strength, speed, aerobic endurance, and specific anthropometric characteristics are associated with better performance assessed with GPS in an amateur Rugby season. In addition, to date, there is little scientific evidence on physical performance and anthropometric profile in Chilean rugby players. Based on the above, the objective of this study is to describe and compare the anthropometric profile and physical condition of the players' positions and analyze their possible associations with sports performance in a season of official matches of amateur rugby players. According to the studies cited, the Bk is hypothesized to be different physically and anthropometrically than the Fw.

Material & methods

Experimental Design

This study has an experimental, observational, descriptive, comparative, and correlational design. The link between physical tests and anthropometric variables with sport performance parameters of a season in amateur Chilean rugby players was investigated and compared according to the playing position. The physical evaluations were carried out the second week of the pre-season. For the demands of the season matches, the GPS data of all the matches of the ARUSA Top 8 tournament year 2021 were recorded.

Subject

In this study, thirty-five Chilean amateur male rugby players were evaluated (± average SD, age, 23.8 ± 4.8 years). All subjects played in the same team. They were divided into 16 Bk and 19 Fw.

Anthropometry

The thickness of the cutaneous folds was used to estimate the percentage of muscle mass and adiposity, using the measurement summation of six cutaneous folds (∑6 skin folds: subscapular triceps, supraspinal, abdominal, mid-thigh, maximal calf). The positioning of each measurement was under the procedure validated by the International Society for the Advancement of Kinanthropometry (ISAK) (Brazier et al., 2020). All measurements were taken before training by an ISAK III-certified expert of the staff of the Club. The skin fold was evaluated using a slim-guide caliper (Rosscraff, British Columbia, Canada) with 0,2 mm precision.

Physical testing

The players were tested during March, in the second week of the pre-season. Physical evaluations were performed on three days alternated with a rest day. On Monday, the assessments of speed for 30 meters, CMJ jump, and hamstring flexibility were carried out. On Tuesday, the maximum aerobic power assessments were carried out, and on Thursday, the maximum strength assessments were carried out.

Maximum aerobic power

This variable was evaluated through the Multistage fitness test (Ramsbottom et al., 1988a), an assessment frequently used in Rugby (Gabbett et al., 2008; Gabbett, 2000b; Ross, Gill, & Cronin, 2015). Players were required to run to the mark back and forth for 20 meters. They proceed to run to the mark along with the sound signal of a speaker. The signal frequency was gradually increased until all the participants dropped from the test. The elimination process occurs when the athletes reach exhaustion and withdraw voluntarily or do not reach the mark in time at least two times in a row. The evaluation was carried out on a natural rugby court, during the afternoon, at 16 °C and with a relative air humidity of 53%. Compared to the evaluation of consumption of direct VO2max, it has been shown that the Multistage is a valid test to measure aerobic resistance and determine the VO2 max (Ramsbottom et al., 1988a). The VO2 max variable was calculated from the running speed reached by the player before failing the test through the following equation (Paradisis et al., 2014):

VO Max = 5,857 x Speed (km/h) – 19,458

Maximum strength

Maximal lower body strength was evaluated through one maximum repetition of a deep squat (1RM ST). They were using free weights according to the procedures previously defined for Rugby players (Alonso-Aubin et al., 2021; Appleby et al., 2019; Baker & Newton, 2008). Before starting the muscle strength assessments, all subjects performed a warm-up consisting of eight repetitions with a stable load of 80 kg. They then lifted progressive loads until the 1 RM was determined. In each repetition, progressive increases of the external load of 10 kg will be carried out. When the player could not execute the repetition, the previous load was considered RM max. 3 min of rest is used between each series. The evaluation was conducted in a closed environment that controlled the room's temperature (18 °C). The variable to be used for the 1RM was the absolute weight in kg of the last series executed before the failure, and the relative strength (RS), was obtained from the coefficient of the 1RM of deep squat/body weight.

The maximum upper body strength was measured through 1RM from Bench Press (1RM BP), according to the protocols previously used with Rugby players (Gabbett et al., 2009; Gabbett, 2000b; Ramsbottom et al., 1988b). Before making the measurement, each player executed a series of eight repetitions with a stable load of 60 kg as a warm-up. Then progressive increases of the external load of 10 kg were made in each of the repetitions. The previous load was considered RM max when the player could not execute the repetition. Players would have a recovery time between sets of 3 minutes. It was deemed to be valid the execution of the or when the bar touched the players' chest and then performed a complete extension of the arms, under the visual supervision of the researcher. The variable used for the 1RM was the absolute weight in kg of the last series executed before the failure.

Hamstring flexibility test (Flex)

This test is frequently used to evaluate the flexibility of the hamstring of rugby players (Guillot, Keraultret, Queyrel, Schobb, & Rienzo, 2019; Raj et al., 2021) Before performing the test, each player performs a warm-up of 3 hamstring flexibility exercises before running the test. They were asked to reach as low as possible with their fingers without performing knee bending and hold the position for 20 seconds in the standing position. Then the same exercise was repeated but with the right foot over the left and vice versa. The activity starts by sitting on the ground with both knees extended, then trying to reach with the tip of the fingers the toes as far as possible, maintaining the position for three seconds. Each athlete made three attempts, marking the distance low (negative) or beyond the feet (positive) with 2 min of rest between the repetitions. The evaluation was conducted in a closed environment that the room's temperature (18 °C). The variable used in this test was the best result recorded in centimeters.

Speed time in 30 Meters (T30)

This test is frequently used to evaluate the maximum running speed of rugby players (Nakamura et al., 2017). Before performing the test, each player performed a specific warm-up of five progressive 30m sprints. Three attempts of 30m were made, with 5 min of rest between each of the repetitions. The evaluation was carried out on a natural rugby field during the afternoon at 16 °C and with a relative humidity of 53%. The starting position was standing, placing one foot in advance about 0.3m behind the first photocell, preventing the participant from blocking the laser beam with his head or arms at the beginning of the race. Two photoelectric cells (Microgate® Bolzano, Italy) were located at the beginning at 30m. The shortest time in seconds of the three attempts was used for this study.

Vertical jump (CMJ)

This test is used to evaluate the power of the limbs of male rugby players (Castagna et al., 2013). Before the evaluation, each athlete performed a specific five-hop warm-up to a 40 cm jump box. In the assessment of CMJ, three jumps were performed with hands on the hips, with three minutes of rest between each of the repetitions. Each athlete was asked to complete a knee and hip flexion followed by a full extension. The depth range of the CMJ was not considered to avoid forcing any coordination difficulties. All hops were performed on an Optojump Microgate® contact platform (Bolzano, Italy). The best of the three results was selected. The evaluation was conducted in a closed environment that controlled the room's temperature (18 °C). The variable used for this work was the best mark in the height of the jump in centimeters.

GPS

The demands of the game were evaluated during 14 matches of the TOP 8 championship. A 5 Hz Global Satellite Positioning (GPS) software (Catapult One, Playertek) was used. From the GPS signal, the distance traveled (Dt) was retrieved (m), maximum speed (Ms) (m / s), high Speed Running > 15 km / h (HSR) (m), and Workload (Wl). The GPS used includes a gyroscope at 100 Hz, from which information on the number of tackles (Tk) (about 6g) was collected. All participants carried the unit on the GPS holder, inside the pocket for the device on the back between the straps, and under the game shirt. Each participant used the same device for all games.

Statistical analysis

All variables are used on the mean with its standard deviation in the descriptive analysis. The Shapiro-Wilk test was used to determine the normal distribution of the variables. On the other hand, The Levene test is used to validate the homogeneity of the variances. The statistical test of independent samples was applied to establish the differences between the playing positions. Correlations were calculated using the person for normal data and Spearman for non-parametric variables. The r values were interpreted as trivial (0,00-0,9), small (0,10 – 0,29), moderate (0,30 – 0,49), large (0,50 – 0,69), very large (0,70 – 0,89), near-perfect (0,90 – 0,99), and perfect (1,0) (Hopkins et al., 2009)The effect size (TE) was calculated using Cohen ES (0.2: small, 0.6: medium, 0.12: large). The significance level was set at p ≤ 0.005 and the confidence interval (IQ) at 95% for all assessments. The analysis will be performed with the SPSS software IBM® v.22 (New York, USA).

Results

Table I shows the differences between the groups in Weight (p=0,001), Height (p= 0,032), % Fat (p=0,018) and ∑6 kind fold (p=0,003). For weight, the Backs group has 17,7% lower body weight than the Forwards group. About the height, size of less than 1,3% is observed for the Backs. In the % Fat, the Backs have 9,2% less % Fat than the Forwards and 27,9% less in the ∑6 kind fold. The variables Age and % Muscle did not show significant differences.

Table I. Anthropometric variables between playing positions. Means ± standard deviation (M ± SD) and 95% confidence interval (CI 95%).

Variables	Backs (n=16)		Forwards (n=19)		Intergroup comparisons	
	M ± SD	**CI (95%)**	**M ± SD**	**CI (95%)**	**P Value***	**Effect SizeΨ**
Age (years)	2 4.0 ± 5.6	(20,9 - 27,0)	22.8 ± 3.9	(20,9 – 24,7)	0.473	-0,19
Weight (kg)	84.3 ± 6.8	(80,6 – 87,9)	98.0 ± 13.5	(91,4 – 104, 5)	0,001	1,92
Size (cm)	178.4 ± 5.4	(175,5 – 181,3)	182.1 ± 4.3	(180,0 – 184,2)	0,032	0,74
% Fat	22.5 ± 2.8	(21,3– 24,1)	25.1 ± 3.2	(23,6 – 26,7)	0,018	0.81
% Muscle	49.1 ± 4.8	(46,6 – 51,7)	49.0 ± 2.7	(47,7 – 50,4)	0.939	0,00
∑6 Folds	68.2 ± 14.7	(60,3 – 76,1)	92.9± 27.9	(79,4 – 106,4)	0.003	1,32

* T-test for independent samples with Levene test to verify the homogeneity of variances. Ψ Effect size by Cohen ES (0.2>: small, >0.6: medium, 0.1>2: large).

Table II shows the comparison between both groups of players for Physical variable fitness. The data highlights the differences in 1RM DS (p = 0,033) and VO2 max (p = 0,015) between the Bk and Fw. Better performance is observed in the Fw in 1RM SD (153, 4 ± 31, 0) over the Bk(134,6 ± 14,3). On the contrary, in the parameter of VO2 max. It is observed that the Group of The Bk (52,6 ± 5,7) obtains 16,3% higher than the group of the Fw (47, 5 ± 5,3). The variables RS, 1RM BP, T30, CMJ, and Flex showed no differences between the groups.

Table II. Physical fitness variables by positions of Rugby amateur players. Means ± standard deviation (M ± SD) and 95% confidence interval (CI 95%).

Variables	Backs (n=16)		Forwards (n=19)		Intergroup comparisons	
	M ± SD	**CI (95%)**	**M ± SD**	**CI (95%)**	**P Value***	**Effect SizeΨ**
1RM ST (kg)	134.6 ± 14.3	(127,0 - 142,3)	153, 4 ± 31, 0	(138,4 – 168,3)	0,033	0,83
FR (1RM ST/BW)	1.6 ± 0.18	(1,5 – 1,6)	1.5 ± 0.3	(1,4 – 1,7)	0.773	-0,51
1RM PB (kg)	103.7 ± 29.2	(88,1 – 119,3)	118, 0 ± 11.6	(112,2 – 123,8)	0.665	0.56
T30(s)	4.3 ± 0.2	(4,1 – 4,4)	4.3 ± 0.2	(4,1 – 4,4)	0,665	-0,05
CMJ (cm)	51, 7 ± 7.7	(47,4 – 56,0)	50, 2 ± 5.5	(47,2 – 53,2)	0,546	-017
VO2max (mL/kg/m)	52.6 ± 5.7	(49,2 -55,9)	47, 5 ± 5.3	(44,8 – 50,1)	0,015	-1,17
Flex (cm)	11, 6 ± 10.6	(5,6 – 17,5)	9.5 ± 6.8	(6,1 – 12,9)	0,511	-0,66

* T-test for independent samples with Levene test to verify the homogeneity of variances. Ψ Effect size by Cohen ES (0.2>: small, >0.6: medium, 0.1>2: large).

Table III shows the difference between the group of players from the seasonal performance data obtained by GPS. It shows the difference in the HSR (p=0,000) and maximum speed (p=0,031) between the Bk and Fw groups in a Rugby season. In HSR, the Bk group (798.2 ± 261.4) obtains a -64,9% higher in meters of acceleration over the Fw (369,1 ± 270,3). About the highest speed, the group of Bk (6,8 ± 1,4) obtains a 2,8% higher Mp than the Forwards (5,7 ± 1,3) in a season of play. The Distance, Tackles, and Player Load variables do not show significant differences.

Table III. Performance GPS variables by positions of Rugby amateur players. Means ± standard deviation (M ± SD) and 95% confidence interval (CI 95%).

Variables	Backs (n=16)		Forwards (n=19)		Intergroup comparisons	
	M ± SD	**CI (95%)**	**M ± SD**	**CI (95%)**	**P Value***	**Effect SizeΨ**
Dt (m)	4226, 9 ± 1575.9	(3387.1 – 5066,6)	3535.9 ± 1398.1	(2862,0 – 4209,8)	0,179	-0,47
HSR (m)	798.2 ± 261.4 *	(658,9 – 937,5)	369.1 ± 270.3	(238, 8 – 499,3)	0.000	-2,81
Tk (6g)	2.7 ± 1.0	(2,1 – 3,2)	2.2 ± 1.7	(1,3 – 3,0)	0,349	-0,79
Wl	217.8 ± 50.7	(190.8 – 244,8)	193.3 ± 63.0	(162,9 – 223,7)	0.220	-0,59
Mp (km/h)	6.8 ± 1.4 *	(6,0 – 7,6)	5.7 ± 1.3	(5,1 – 6,4)	0,031	-0,77

* T-test for independent samples with Levene test to verify the homogeneity of variances. Ψ Effect size by Cohen ES (0.2>: small, >0.6: medium, 0.1>2: large). Dt: Distance traveled; HSR: High Speed Running; Tk: Tackles; Wl: Workload; Mp: Maximum speed.

Table IV shows the correlations between anthropometric and performance in session variables.

Table IV. Correlation between anthropometric and performance GPS variables.

Variables	Age	Weight	Height	% Fat	% Muscle	∑6 kind fold
Dt (m)	0,15	-0,029	-0,007	-0,001	-0,056	0,065
HSR (m)	0,13	-0.48**	-0,161	-0,34	0,27	-0.46**
Tk (6g)	0,14	-0,24	0,035	-0,123	0,075	-0,31
Wl	0,047	-0,08	-0,05	-0,083	0,001	-0,009
Mp (km/h)	-0,089	-0,23	-0,2	-0,12	0,11	-0,013

** Correlation is significance at the 0.01 level (bilateral). * Correlation is significance at the 0.05 level (bilateral). Dt: Distance traveled; HSR: High Speed Running; Tk: Tackles; Wl: Workload; Mp: Maximum speed. %Fat: Percentage of body fat. % Muscle: Percentage of muscle mass. ∑6: Sum of six skin folds.

Figure I Shows the simple linear regressions between Sprint and anthropometric variables. A moderate difference associated with Weight and ∑6 kind fold was found. There is no evidence of associations with age, Height, %Fat, and %Muscle in any of the variables of Sports Performance.

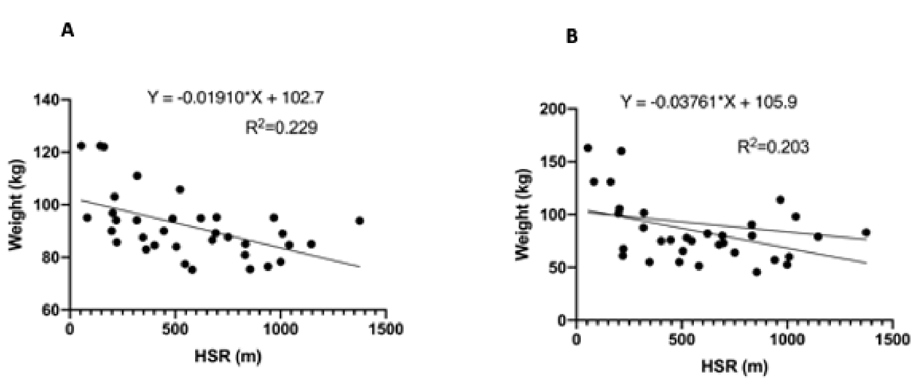

Figure I. Simple linear regressions between HSR and anthropometric variables (A): Weight; (B) ∑6 kind fold.

Table V shows the correlations between the physical variables and the performance of a playing season.

Table V. Correlation between physical fitness and performance GPS variables.

Variables	1RM DS	RS	1RM BP	VO2 max	CMJ	T30	Flex
Dt (m)	-0,01	-0,08	0,04	0.26	0.30	-0,05	0.25
HSR (m)	-0,14	0,14	-0,24	0.70**	0.27	0,16	0.28
Tk (6g)	-0,09	0,08	-0,18	0.59**	0,40*	0,10	0,41*
Wl	0,01	0,042	-0,14	0.44**	0.37*	-0,04	0.30
Mp (km/h)	-0.007	0,14	-0,2	0.30	0.25	-0,44	0.15

** Correlation is significant at the 0.01 level (bilateral). * Correlation is significant at the 0.05 level (bilateral). Dt: Distance traveled; HSR: High speed Running; Tk: Tackles; Wl: Workload; Mp: Maximum speed. 1RM DS: One repetition maximum deep squat; RS: relative strength; 1RM BP: One repetition maximum bench press; T30: time to Sprint 30m; CMJ: Countermovement jump; FLEX; Hamstring flexibility.

Figure II shows a simple linear regression between VO2max and performance variables. A significant association with HSR was found, an extensive relationship for the Variable Tackles and moderate for Player Load. There is no evidence of associations with any other performance variable. For CMJ, only moderate associations were found between the variables Tackles and Player Load. A moderate association with the performance variables was evidenced for the FLEX variable. On the other hand, the physical variables 1RM DS, RS, 1RM BP, and T30 do not show associations with any performance variable measured in this study.

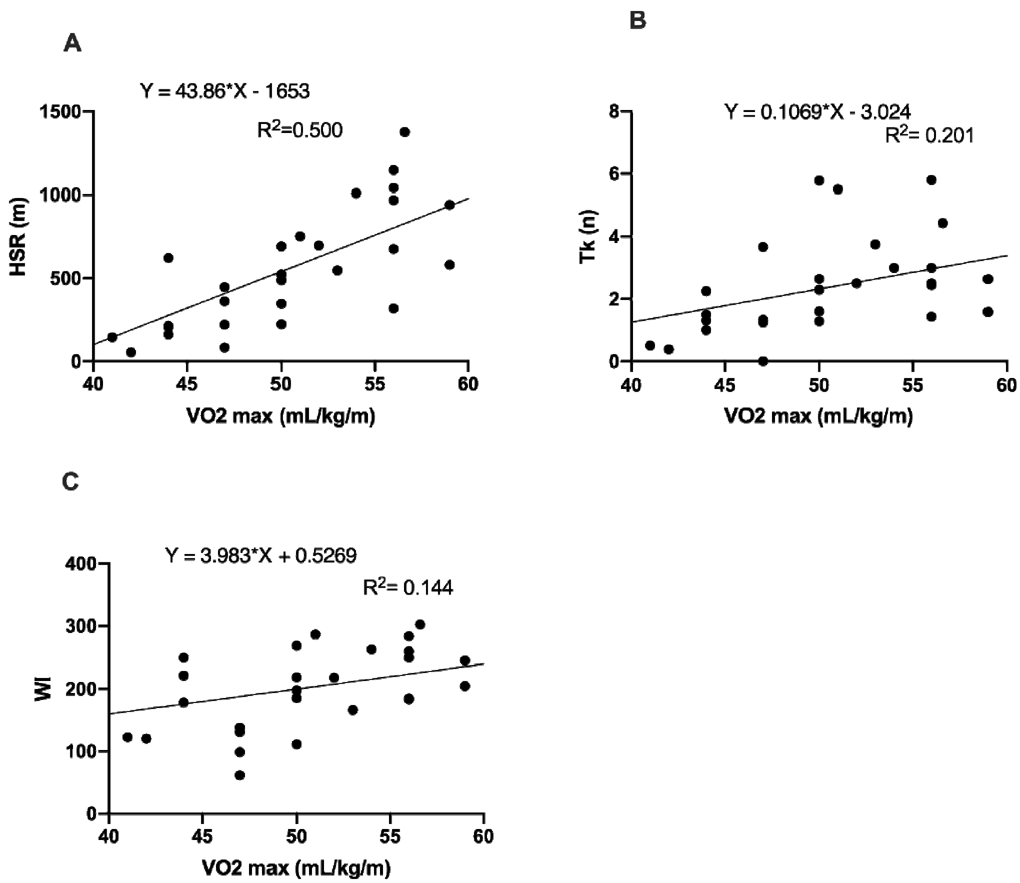

Figure Figure II. Simple linear regression between VO2 and performance ranges (A): HSR; (B): Tackles; (C): Workload.

Dicussion

This research aimed to describe and compare the anthropometric and fitness profile of the playing positions and analyze their possible associations with sporting performance in a season of official matches of amateur rugby players.

The findings of this study in the anthropometric variables (Table I) indicate that there were differences between both positions of players in the variables Weight (p = 0,001) (TE = 1,92), Height (p = 0,032) (TE = 0,81), % Fat (p = 0,018) (TE = 0,81) and ∑6 Folds (p = 0,003) (TE = 1,32), with the Bk being the ones with the lowest values in weight, height, fat and folds got. For the variables of Weight and Height, the data obtained are in line with those reported by Hamlin et al. (Hamlin et al., 2021). Who found significant differences for the Weight (82,3 ± 6,7 vs. 99,7 ± 10,2), Height (180,4 ± 4,7 vs. 186,7 ± 5,7) and ∑6 Folds (94,1 ± 25,64 vs. 65,6 ± 16,7). These results are similar to those obtained by Nakamura et al., (2017) in Brazilian players, where the Bk presented significantly smaller differences in Weight and Height (TE = 1,32; TE= 1,32) than the Fw. The literature has found that elite athletes' body mass and height have been increasing with time and is very forceful in defining that the Bk are lighter, with less height and less thickness of folds than the Fw (Brazier et al., 2018; Meir et al., 2001). Regarding the % of Fat, the results obtained align with those raised by scientific evidence, where the Bk have lower body fat than the Fw (Lacome et al., 2014). This anthropometric characteristic could be associated with the need to have a better power/speed to meet the speed requirements of the Bk (Zúñiga-Vergara & Castro, 2021). The case of the Fw the Body fat could serve as a shock absorber in physical contact situations. The different characteristics of the game and physical demands between both positions condition the apparent differences between height and weight in both positions (Lacome et al., 2014). It is generally accepted that in athletes competing at higher standards, a better level of competition is associated with lower % body fat and a higher % of muscle mass (Duthie et al., 2003a).

Table II shows the results obtained in the physical fitness assessments. As for 1RM ST, the Fw obtained higher values than the Bk ($p < 0,05$). This difference is reversed in the variable FR related to the muscular strength of the lower extremities, concerning body weight, where the group of the Bk achieve a better relative strength than the Fw. However, these differences are not enough to be significant. Apparent differences have been found in 1RM ST. Where the Fw seem to have greater strength in 1RM squat (Meir et al., 2001; Smart et al., 2014; Smart et al., 2013). The evidence seems to agree that Fw are stronger in relation to absolute strength. There are no statistically significant differences when expressed in relation to body mass (Comfort et al., 2011). For the variable of 1RM PB, our work managed to find average values between both groups, where the Fw achieve higher values than the Bk. Although, these values did not manage to reach statistical significance. In contrast, previous research seems to identify differences in PB 1RM. The study of, Hamlin et al., (2021) in amateur English players. It was evidenced that the group of Fw have higher levels of strength in 1RM PB than the Bk ($p < 0,05$). This logic is similar to that reported for the variables of CMJ and T30. Our work finds differences between the two groups but fails to be statistically significant. On the other hand, in the study by Nakamura et al., (2017) differences were found in CMJ (TE= 1,08) and T30 (TE= 1,07). This is in line with other studies that reported significant differences in the speed and power of legs between both players (Hamlin et al., 2021). These differences could be rooted in the competitive level of the leagues and the development of the sport in the country. Overall, the literature clearly states that having high levels of muscle strength and power is crucial in Rugby (Brazier et al., n.d.). Better levels of muscle strength will allow the athlete to perform more or more accurately in all situations of contact and displacement of the game (Duthie et al., 2003b; Gabbett, 2016).

Regarding the performance of aerobic power (VO2max), differences were detected between both playing positions ($p< 0,02$). The Fw obtained results significantly worse than the Bk. These results are consistent with those found in Rugby New Zealand players. The Bk get higher consumption values of VO2 max than the Fw ($p = 0,001$). In sports, it is generally known that obtaining a high VO2 maximum can help increase the repetition of high-intensity efforts and the distance traveled (Duthie et al., 2003b). These differences between the game positions in the VO2 max could be related to the game's physical demands, which require the Bk to travel greater distances at a greater intensity of play than the Fw (Zúñiga-Vergara & Castro, 2021).

In relation to the results of the game performance variables during an official Rugby season (Table III). As for HSR, the Bk obtained significantly higher levels than the Fw ($p< 0,001$). These findings are in line with those reported by the literature, where it has been established that Bk complete more significant high-intensity efforts than Fw (Sheehan et al., 2022). The same results were found in professional players of the English league who found differences between Bk and Fw in the frequency of high-intensity actions (35,2 ± 11,1 vs 14,9 ± 8,6), the total distance of accelerations (316 ± 117 vs 119 ± 86 m) and the maximum speed (30,1 ± 2,9 vs 25,2 ± 1,2 km/h) (Waldron et al., 2011). From the variable Vm, it was observed that the group of Bk was able to develop higher maximum speeds than Fw (TE = -0.77). Previous studies have reported that the Bk group achieves higher speed spikes during the game (Waldron et al., 2011). In the article by Johnston et al., (2019) it shows that the Bk has higher running speeds in both professional and amateur players. In general, the evidence is overwhelming in pointing out that the Fw are slower than the Bk (Meir et al., 2001; Waldron et al., 2011; Zúñiga-Vergara & Castro, 2021). This characteristic could be related to the fact that the Fw are closer to the center of the court and with less space to move.

Tables IV and V show the relationships between anthropometric and physical profile and sports performance in a Rugby season. Concerning the anthropometric characteristics, (Figure 1) shows the relations of Weight (R2= 0,229) and ∑6 Folds (R2= 0,20) with HSR, showing statistical significance ($p< 0,01$). Therefore, it is shown that both Weight and ∑6 Folds are negatively associated with performance in HSR; that is, the lower the Weight or, the lower the ∑6 Folds of the player, the greater the distance in high intensity the athlete will develop during the playing season. These results are similar to those reported by Perroni et al., (2018) where a moderate association ($r=0,58$) ($P> 0,01$) was established between Weight and high-intensity actions for collective sports athletes. In Rugby players, it has been shown that body weight has an extensive association ($r=0,72$) ($P> 0,01$) with sports performance variables (Pasin et al., 2017). About the variable ∑6 Folds, another

part, the study of Posthumus et al., (2020) with professional New Zealand rugby players, managed to demonstrate the existence of an extensive association (r = 0.75) with acceleration variables (20 meters). These results suggest that anthropometric variables of weight and ∑6 Folds could provide information regarding the ability to perform high-intensity actions in an official Rugby season.
Interestingly, the study by Smart et al., (2014) proposed emphasizing the development of speed and acceleration qualities because they are related to game situations such as breaking lines, breaking tackles, and converting points, all-important behaviors for performance and sports success. Our research observed that Fw with greater skin folds and body weight might have slower acceleration times in the season. So both measures appear as essential variables for monitoring performance in a gaming season.

For the variables of the physical profile (Figure II), the associations obtained with VO2max and the variables of sports performance such as; HSR (R^2= 0,50), Tk (R^2= 0,20), and Wl (R^2= 0.24) with a statistical significance of (p< 0,01). Therefore, it could be determined that VO2 max is significantly associated with the results in the HSR, Tk, and Wl variables of sports performance. These findings align with what Jones et al., (2016) said in professional rugby players found a strong association between HSR and metabolic potency (r=0,98). Although the methods for estimating metabolic power differed from those used, the researchers found that higher metabolic power is associated with higher values in the distance at high intensity in a match. In another study, where a measurement of direct oxygen consumption was performed, a moderate association was found between VO2max (r=0,50) with HSR measured with GPS (Highton et al., 2017). In another study, professional athletes inversely correlated the VO2 maximum with the ability to perform HSR repeatedly (Jones et al., 2016).

For the Wl, the literature has shown that in university rugby players, there is a moderate relationship (r = 0,37) between VO2max (direct measurement) and Wl (Highton et al., 2017). The differences with our work could lie in the context of measurement (measurements through exercises) and were not evaluated in the context of sports competition. While this allows direct VO2max values to be obtained, it is not representative of the Wl of an official match. Another study with Rugby Sevens players found a moderate association (r=0,36) between Wl and Multi-Stage Fitness Test values (Ross, Gill, Cronin, et al., 2015). The main differences could be related to the length of the matches. The Rugby Sevens has a total duration of 14 min per game versus the 80 min of Rugby (Zúñiga-Vergara & Castro, 2021). On the other hand, this study dealt with value in meters of the Test and not the indirect formula of VO2max. Concerning Tk, previous evidence in professional Rugby Sevens players has found a very low association (r=0,11) between the Multi-Stage Fitness Test and Tk (Ross, Gill, Cronin, et al., 2015). Although, similarities have been reported between the two sports. The differences in results may be related to the sport's demands, the players' characteristics, and the similarity between the playing roles in the Rugby Sevens (Zúñiga-Vergara & Castro, 2021). The factors that could influence having an improved VO2max may be related to the ability to tolerate, eliminate, and cushion in a better way the muscle waste that works in a Rugby match, allowing them to repeat more frequently the ability to execute HSR, Tk, and thus influence the Wl (Sahlin & Henriksson, 1984). It is essential to consider that it is impossible to define a target for any anthropometric or physical characteristic that guarantees performance for Rugby players. The ability to read the game, make decisions, and communicate with the rest of the team are fundamental aspects of group dynamics and performance.

Future studies could monitor decision-making within the season, associate it with the anthropometric and physical profile and thus establish the real impact of the anthropometric and physical profile on decision-making and sports performance. Future studies could also explore the effect on body composition and fitness of the season and thus determine changes in profiles. This would allow working on individual differences and optimizing the players' nutrition plans and strength plans. The current study's limitations were that we could only use a small sample of amateur rugby players and only group players into two large groups (Bk and Fw). A more extensive sample could allow a more detailed grouping of each player's anthropometric and physical characteristics (Johnston et al., 2019; Sheehan et al., 2022; Waldron et al., 2011) and thus analyze more precisely the differences and associations with the players' performance.

Conclusions

In conclusion, we can report differences in anthropometric and physical profiles between the Bk and the Fw in Chilean amateur Rugby. This study also noted that anthropometric measures of Weight and ∑6 Folds are moderately associated with the performance of accelerations in an official Rugby season. The Bk are significantly lower, less heavy, less % fat, and with a smaller size of the skin folds. In the physical part, we find that the Bk have a lower absolute strength in a deep squat and a greater aerobic capacity than the group of the Fw. On the other hand, this study showed that the anthropometric variables of Weight (kg) and Σ6 Skindfolds (cm) are moderate associated with the ability to perform greater distance at high speed during an official match season. In the same line, the VO2max was associated primarily and moderately with the sports performance variables HSR, Tk, and Wl, respectively, for all Rugby team players.

Through the results of this study, coaches can obtain reference data on anthropometric and physical fitness profiles before the start of a Rugby season. On the other hand, the data allow us to associate which variables have a relationship with the performance in the game season. This study can set individual goals with athletes during a pre-season. Or as a point of comparison to guide the process of monitoring and follow-up of strength and nutrition programs. Our data showed that coaches should follow an individualized follow-up plan to develop anthropometric and physical characteristics according to the demands and level of the game.

Conflicts of interest

The author(s) declared no have conflict of interest concerning this work, authorship, and/or publications of this paper.

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