Research article
DOI: 10.17533/udea.efyd.e357590

Analyzing Physical Fitness and Anthropometry of Child and Adolescent Rugby Players in Brazil

Análisis de condición física y antropometría de jugadores de rugby infantiles y juveniles en Brasil

Análise de condicionamento físico e antropometria de jogadores de rugby infantis e adolescentes no Brasil

Filipe Oliveira Bicudo[1]
Erivaldo Machado Araújo[2]
Jaciaria Paula Oliveira de Jesus Garcia[3]
Lucas Savassi Figueiredo[4]
Alexandre Konig Garcia Prado[5]
Henrique de Oliveira Castro[6]

[1] Specialist in Strength and Hypertrophy Training. Member of 'Grupo de Estudos e Pesquisas em Educação Física e Esportes (GEPEFE/UFMT)'. Head Coach of the 'Melina rugby Clube'. Researcher at Universidade Federal de Mato Grosso, Cuiabá, Brazil. Email:filipebicudo@gmail.com
ORCID: 0000-0003-4109-224X

[2] Master's in Physical Education. Member of 'Grupo de Estudos e Pesquisas em Educação Física e Esportes (GEPEFE/UFMT)'. Assistant Professor at Centro Universitário do Distrito Federal, Brasilia, Brazil. Email: erivaldorpg@hotmail.com
ORCID: 0000-0002-5444-4163

[3] Physical Education Teacher. Member of 'Grupo de Estudos e Pesquisas em Educação Física e Esportes (GEPEFE/UFMT)', Cuiabá, Brazil. Email: jaci0812@gmail.com
ORCID: 0000-0003-0158-8283

[4] Doctor in Sports Sciences. Member of 'Grupo de Estudos e Pesquisas em Educação Física e Esportes (GEPEFE/UFMT)' and 'Grupo de Pesquisa em Educação Física e Ciências do Esporte (UFRPE/CoMNeuro UFJF)'. Adjunct Professor at Universidade Federal de Juiz de Fora, Governador Valadares, Brazil. Email: savassi88@hotmail.com
ORCID: 0000-0001-5853-4978

[5] Doctor in Human Movement Sciences. Member of 'Grupo de Estudos e Pesquisa em Atividades Aquáticas e Fisiologia do Exercício (GEPAFE)'. Adjunct Professor at the Universidade Federal de Mato Grosso, Cuiabá, Brazil. Email: akgprado@gmail.com
ORCID: 0000-0003-3393-1074

[6] Doctor in Sports Sciences. Member of 'Grupo de Estudos e Pesquisas em Educação Física e Esportes (GEPEFE/UFMT)'. Adjunct Professor at the Universidade Federal de Mato Grosso, Cuiabá, Brazil. Email: henriquecastro88@yahoo.com.br
ORCID: 0000-0002-0545-164X

How to reference

Bicudo, F. O., Araújo, E. M., Garcia, J. P. O. de J., Figueiredo, L. S., Prado, A. K. G., & Castro, H. de O. (2024). Analyzing Physical Fitness and Anthropometry of Child and Adolescent Rugby Players in Brazil. *Educación Física y Deporte, 43*(1), 55-76. https://doi.org/10.17533/udea.efyd.e357590

ABSTRACT

This study analyzed the physical fitness and anthropometric characteristics of young Brazilian rugby players, considering sex, age group, and playing position. The sample consisted of 106 children (U13 and U15) and adolescent (U17 and U19) Brazilian rugby players of both sexes. Anthropometric characteristics (body mass, height, waist circumference, body mass index, and waist-to-height ratio) and physical fitness performance (abdominal muscle strength, horizontal jump test, 20-m linear sprint, push-ups, and 5-10-5 agility test) were assessed by an experienced researcher after a standardized warm-up. Results varied by sex, age group, and playing position. Overall, with few exceptions, male and adolescent players had higher levels of both physical fitness and anthropometric characteristics. Similarly, playing position analysis revealed specific patterns

that reflect the demands of each distinct position on the field. This study provides generalizable, position-specific metrics that may be useful to the rugby community.

KEYWORDS: anthropometry, body mass index, physical fitness, playing position, rugby, youth rugby.

RESUMEN

Este estudio analizó la condición física y las características antropométricas de jóvenes jugadores brasileños de rugby, teniendo en cuenta el sexo, la edad y la posición en el terreno de juego. La muestra constaba de 106 jugadores brasileños de rugby de ambos sexos, de las categorías sub-13, sub-15, sub-17 y sub-19. Un investigador experimentado midió las características antropométricas (masa corporal, altura, circunferencia de la cintura, índice de masa corporal y relación cintura-estatura) y el rendimiento físico (fuerza muscular abdominal, prueba de salto horizontal, sprint lineal de 20 m, flexiones de brazos y prueba de agilidad 5-10-5) después de un calentamiento estandarizado. Los resultados variaron en función del sexo, la edad y la posición en el terreno de juego. En general, con pocas excepciones, los jugadores masculinos y juveniles presentaron un mayor nivel de condición física y características antropométricas. Del mismo modo, el análisis de la posición de juego reveló patrones específicos que reflejaban las exigencias de cada una de ellas. Este estudio proporciona métricas generalizables y específicas de la posición que pueden resultar útiles para la comunidad del rugby.

PALABRAS CLAVE: antropometría, índice de masa corporal, condición física, rugby, rugby juvenil.

RESUMO

O estudo analisou o condicionamento físico e as características antropométricas de jovens jogadores de rugby brasileiros, considerando sexo, faixa etária e posição de jogo. A amostra consistiu em 106 jogadores de rugby, de ambos os sexos, das categorias infantil (sub-13 e sub-15) e juvenil (sub-17 e sub-19). Um pesquisador experiente mediu as características antropométricas (massa corporal, altura, circunferência da cintura, índice de massa corporal e relação cintura/altura) e o desempenho de condicionamento físico (força muscular abdominal, teste de salto horizontal, corrida linear de 20 m, flexões e teste de agilidade 5-10-5) após um aquecimento padronizado. Os resultados variaram de acordo com o sexo, a faixa etária e a posição de jogo. Em geral, com algumas exceções, os jogadores masculinos e juvenis apresentaram níveis mais altos de condicionamento físico e características antropométricas. Da mesma forma, a análise da posição de jogo revelou padrões específicos que refletem as exigências de cada uma. Este estudo fornece métricas generalizáveis e específicas para cada posição, que podem ser úteis para a comunidade do rugby.

PALAVRAS-CHAVE: antropometria, índice de massa corporal, condicionamento físico, rugby, rugby juvenil.

INTRODUCTION

Rugby is a field invasion sport characterized by high-intensity activity and collisions (Ross et al., 2014). Since its inclusion in the 2016 Olympic Games, the sport has experienced a growth in popularity worldwide, leading to an increase in national rugby programs in several countries (Engebretsen & Steffen, 2010; Fuller et al., 2017). This growth has also attracted the interest of researchers to better understand the demands of the sport (Henderson et al., 2018).

Brazil has followed a similar trend. Since the sport arrived in the country at the end of the 19th century (Gutierrez et al., 2017), it has grown steadily, with an increasing number of practitioners and competitions. Today, there are thousands of regular practitioners and several teams throughout the country. In recent years, efforts have been made to increase the practice of rugby XV (15-a-side rugby) throughout the country, with players migrating from rugby sevens to rugby XV. Although young athletes should avoid early specialization in specific positions due to their early stages of physical development, positional differentiation has been to enhace player safety, particulary during scrums.

This increases participation, especially among children and young people. With the growing demand for rugby, it is necessary to understand the characteristics that may influence their performance in the sport. Additionally, rugby is a sport whit high physical demands, requiring attributes such as speed, power, strength, and agility, which requires several physical characteristics from athletes and practitioners of this modality (Lopes et al., 2011). Recent studies have focused on the anthropometric and physical characteristics of male athletes from different categories who compete in this sport (Gabbett, 2005; Sella et al., 2019). Differences among young competing athletes have been observed (Chiwaridzo et al., 2024; Owen et al., 2020; Pino-Ortega et al., 2021; Scantlebury et al., 2022), in addition to the specifics demands of each playing position (Owen et al., 2022).

For instance, it is well established that senior forwards have a higher body weight and fat percentage than back players (Dacres-Manning, 1998), but the difference between forwards and backs diminishes as the level of play increases. It has also been demonstrated that first-level senior forwards (11.1 ± 1.2%) have a lower body fat percentage than second-level athletes (13.3 ± 1.0%) (Rigg & Reilly, 1988). A strong correlation has been observed between body mass and strength in the scrum, and

recently, high mobility in senior forwards has been associated with high muscle mass and low fat mass (Duthie et al., 2003).

Differences in physical attributes have been suggested as key discriminators between playing standards and age categories in rugby union (Jones et al., 2019). Anthropometric and physiological factors are often analyzed together, as body mass and speed correlate with force production and momentum, which are critical in the sport (Barr et al., 2014). For rugby union players, positional differences are crucial as different roles require different anthropometric profiles. Indeed, in males, even at a young age, forwards were found to be heavier, taller, and older than U15 and U21 French (Sedeaud et al., 2012) and U16 Irish (Delahunt et al., 2013) back players, with body mass being the significant predictor of role position.

In addition, fat percentage also serves as distinguishing factor among players, with variations based on playing position (Fontana et al., 2015). However, in female players, the physical characteristics between forwards and backs are less pronounced compared to male players (Quarrie et al., 1996; Smart et al., 2013), and these positional differences are also less clear at lower standards, suggesting that physical performance and anthropometric characteristics are less pronounced in female rugby. Despite this, some studies have reported an increase in body mass over the years, as the standard of the female game has improved (Woodhouse et al., 2022). However, such determinants of physical performance have not yet been reported for young female players.

Overall, previous research has shown that elite male rugby union players exhibit superior physical characteristics compared to sub-elite male players, such as: (a) maximal speed, (b) acceleration, (c) momentum, (d) maximal strength, (e) peak power, (f) agility and change of direction performance, and (g) speed endurance and aerobic qualities (Dimundo et al., 2021). In addition, it is well established that rugby union has a clear diversification of physical demands for forwards and backs in

terms of total distance, accelerations, and number of collisions (Cahill et al., 2013; Deutsch et al., 2007; Smart et al., 2013; Vaz et al., 2016; World Rugby, 2023).

Among, female athletes, some studies have also reported on the differences between the physical characteristics of forwards and backs, and the results are somewhat similar to those reported for male athletes (Woodhouse et al., 2022; Yao et al., 2021). However, no studies have compared the physical characteristics of athletes at different levels of play, and all available studies have examined elite athletes only.

A comprenhensive understanding of physical fitness and anthropometric characteristics across different sexes, age categories, and playing positions may provide important information for the development of specific training programs (Tessutti et al., 2019), in addition to being useful for coaches and technical staff to improve the competitive performance of young rugby players. The results of this study can also help to understand how young Brazilian athletes perform compared to their peers from other countries, which is important information given that the main goal of the Confederação Brasileira de Rugby (CBRu) is to compete at the highest level.

Therefore, this study aimed to analyze the physical fitness and anthropometric characteristics of young Brazilian rugby players, considering sex, age category, and playing position. The first hypothesis is it that male players could have a greater height, body mass and better performances in physical fitness performances compared to female players, as well as older players compared to younger ones.

The second hypothesis relates to the positional group, where it is expected that front row forwards will have larger body mass and better performance on physical strength assessment compared to back row forwards and backs. However, it is expected that backs will have superior performance on speed and agility tests compared to front row forwards and back row forwards, following a worldwide trend.

METHODS

Participants

Se The sample was defined by convenience and classified as non-probabilistic and consisted of 106 young Brazilian rugby players from the child (U13 and U15) and youth (U17 and U19) age groups (64 males: 32 boys and 32 adolescents; 42 females: 22 girls and 20 adolescents). All players who completed all suggested tests were included in the study.

Study Design

This study was approved by the University Research Ethics Committee, under protocol number 6.249.079 (CAAE: 72676623.7.0000.8124) and followed the ethical recommendations of the Declaration of Helsinki for the study of human subjects.

Participants received a verbal explanation of the experimental design of the study. All tests were administered by an experienced researcher, and the order of testing was the same for all players: anthropometric characteristics were measured first, followed by the measurement of physical performance. Verbal encouragement was provided during all testing to ensure that the players performed to the best of their ability. Testing lasted approximately 25-30 minutes for each player and was conducted at the Melina Rugby Training Center (Cuiabá, Brazil) between 08:00 and 10:00. All players were given a standardized warm-up consisting of 10 minutes of drills and 5 minutes of static and dynamic stretching. This protocol was used in the Tessutti et al. (2019) study.

For data collection, the anthropometric characteristics (body mass, height, waist circumference, body mass index (BMI), and waist-to-height ratio) and the physical fitness performance measures (abdominals, horizontal jump test, and 20-m linear sprint) were measured according to the PROESP-BR protocol (Gaya et al., 2021; Mello et al., 2016; Pelicer et al., 2016;

Tessutti et al., 2019). Push-up test was measured according to the protocol described in the studies by Tessutti et al. (2019) and Pelicer et al. (2016), and the 5-10-5 agility test was measured according to the protocol described in the *Manual de Testes Físicos: Brasil Rugby 2019-2023* (Guerriero et al., 2020).

Anthropometric Characteristics

Body mass and height were measured using an electronic weight scale with a stadiometer (Filizola Inc.®, Brazil), with an accuracy of 0.1 kg and 0.1 cm, respectively. Waist circumference was measured using a flexible tape measure with a resolution of 0.1 cm (Sunny®, Brazil), and the measurement was taken at the midpoint between the lower edge of the last rib and the upper edge of the iliac crest. BMI was calculated as the body mass (kg) divided by the square of height (m^2) and expressed in kg.m-2. Waist-to-height ratio was calculated as the ratio (division) of waist circumference to height in cm [waist(cm)/height(cm)].

Measuring Physical Fitness

• ***Abdominal Muscles:*** The abdominal strength/resistance was assessed using the trunk flexion test, where players performed the maximum number of repetitions of the abdominal exercise for 1 minute.

• ***Horizontal jump test:*** The measurement was made with a tape measure fixed to the ground, perpendicular to the starting line. The start line was indicated by one of the lines marking the field. The zero point of the tape measure was on the start line. The player stood immediately behind the start line with parallel feet and slightly apart, knees slightly bent, and upper body slightly forward. At the signal, the athlete jumped with both feet simultaneously as far as possible. The result was recorded in cm.

• ***Push-up test:*** Upper body strength and endurance were assessed by performing the 90° push-up test for 1 minute. The number of repetitions was recorded.

• ***5-10-5 agility test:*** Performance was determined by the time to complete the task. The athlete begins the test standing perpendicular to the midline with the fingertips of the left hand touching the ground. The athlete runs to the right, touching the right foot and hand at or beyond the 5m line, changes direction 180°, runs 10m, touching the left hand and foot at or beyond the line, changes direction 180° again and, finishes in the same place where the test began. Each athlete performed two trials in a 1-minute rest in-between. The best time was recorded.

• ***20-m linear sprint:*** Linear speed was determined by the execution time (seconds) of a timed 20-m linear sprint. Timing began when the subject moved from a 2-point (base-running) stance. Linear sprint times were determined using a speed digital handheld stopwatch (Germany, -0.04 ± 0.24 s). Three trials were performed in a 1-minute rest between each trial. The best time was recorded.

Statistical Analysis

Data normality was analyzed using the Shapiro-Wilk test. For variables with non-normal distribution, logarithmic transformation, radius transformation, or reciprocal transformation was used, depending on the characteristics of the data distribution. Three-Way ANOVA was used to test the effect of sex, category, and position on physical performance and anthropometric variables, a. Specific differences in the position factor were identified using the Bonferroni post hoc. The significance level used was $\alpha \leq 0.05$. Data were analyzed using the SPSS statistical package, version 18.0.

RESULTS

There were no statistically significant interactions among the factors were found. A main effect for sex was found for seven variables. Male athletes had greater height ($p < 0.001$), body mass ($p < 0.001$), abdominal repetitions ($p = 0.016$), horizontal jump test ($p < 0.001$), agility ($p < 0.001$), and speed ($p < 0.001$) than female athletes did, but performed fewer arm flexion repetitions ($p = 0.017$). See Table 1.

	Sex				ANOVA	
	Male		**Female**		**(main effects)**	
	Mean	**± SD**	**Mean**	**± SD**	**F**	**p**
Body Mass (kg)	63.59	± 16.19	55.42	± 11.00	13.250	**< 0.001**
Height (cm)	171.08	± 10.14	158.79	± 7.98	39.404	**< 0.001**
Waist Circumference (cm)	75.07	± 9.89	73.61	± 7.47	1.713	0.194
BMI (kg·m^{-})	21.49	± 4.22	21.88	± 3.25	0.003	0.954
Waist-to-Height Ratio (cm)	0.44	± 0.05	00.46	± 0.05	3.103	0.081
Abdominals (repetitions)	41.86	± 8.37	35.86	± 6.72	5.976	**0.016**
Horizontal Jump Test (cm)	1.83	± 0.31	1.45	± 0.20	28.341	**< 0.001**
Push-Ups (repetitions)	30.02	± 10.40	35.57	± 10.37	5.929	**0.017**
5-10-5 Agility Test (s)	6.06	± 0.43	6.66	± 0.49	19.196	**< 0.001**
20-m Linear Sprint (s)	3.95	± 0.33	4.37	± 0.29	23.461	**< 0.001**

A main effect of category was found for six of the ten variables analyzed. Athletes in the juvenile category had significantly greater height ($p = 0.034$), body mass ($p = 0.011$), BMI ($p = 0.049$), horizontal jump test ($p = 0.050$), agility ($p = 0.037$), and 20-m sprint tests ($p = 0.043$) than athletes in the infantile category (Table 2).

Table 2. *Mean ± standard deviation of player characteristics between categories and results of main effects ANOVA*

	Category				ANOVA (main effects)	
	Children		Youth			
	Mean	± SD	Mean	± SD	F	p
Body Mass (kg)	56.71	± 16.01	64.13	± 12.63	6.682	**0.011**
Height (cm)	163.19	± 11.72	169.35	± 9.53	4.639	**0.034**
Waist Circumference (cm)	73.53	± 9.93	75.49	± 7.89	1.061	0.306
BMI ($kg \cdot m^{-2}$)	21.07	± 4.38	22.24	± 3.15	3.978	**0.049**
Waist-to-Height Ratio (cm)	0.45	± 0.06	0.45	± 0.04	0.064	0.801
Abdominals (repetitions)	38.48	± 8.45	40.49	± 8.01	1.228	0.271
Horizontal Jump Test (cm)	1.60	± 0.31	1.76	± 0.33	3.929	**0.050**
Push-Ups (repetitions)	30.48	± 12.23	34.02	± 8.57	0.089	0.766
5-10-5 Agility Test (s)	6.43	± 0.55	6.16	± 0.50	4.496	**0.037**
20-m Linear Sprint (s)	4.20	± 0.36	4.03	± 0.38	4.227	**0.043**

Only abdominal strength and the horizontal jump test did not show a main effect of position factor. *Post hoc* analysis showed that front row players had significantly greater body mass ($p < 0.001$), waist circumference ($p < 0.001$), BMI ($p < 0.001$), and waist-to-height ratio ($p < 0.001$) than back players and greater body mass ($p = 0.023$), waist circumference ($p = 0.018$), BMI ($p = 0.007$), and waist-to-height ratio ($p = 0.008$) than back row players. In contrast, back players performed a greater number of push-up repetitions ($p = 0.022$) and completed the agility test in less time ($p < 0.001$) than front row players. Back players also had a significantly shorter 20-m linear sprint time compared to front row ($p < 0.001$) and back row players ($p = 0.009$) (Table 3).

Table 3. *Mean ± standard deviation of player characteristics between playing positions and results of main effects ANOVA*

	Position						ANOVA(main effects)	
	Front Row		Back		Back Row			
	Mean	± SD	Mean	± SD	Mean	± SD	F	p
Body Mass (kg)	71.93	± 19.68*#	56.46	± 11.35	59.39	± 10.29	16.221	< 0.001
Height (cm)	168.00	± 11.81	165.35	± 10.46	167.29	± 13.12	3.557	0.032
Waist Circumference (cm)	82.11	± 12.37*#	72.00	± 6.34	73.55	± 5.92	11.885	< 0.001
BMI (kg·m^{-2})	25.13	± 4.72*#	20.52	± 2.97	21.16	± 2.39	14.883	< 0.001
Waist-to-Height Ratio (cm)	0.49	± 0.06*#	0.44	± 0.04	0.44	± 0.05	8.312	< 0.001
Abdominals (repetitions)	35.37	± 7.65	41.12	± 8.19	38.50	± 7.46	2.852	0.063
Horizontal Jump Test (cm)	1.52	± 0.24	1.73	± 0.34	1.70	± 0.30	2.164	0.121
Push-Ups (repetitions)	28.17	± 9.46*	34.59	± 10.77	27.64	± 9.21	6.155	0.003
5-10-5 Agility Test (s)	6.60	± 0.46*	6.18	± 0.55	6.33	± 0.45	3.679	0.029
20-m Linear Sprint (s)	4.37	± 0.32*	4.01	± 0.36	4.25	± 0.27*	8.228	0.001

Note. (*) Statistically significant difference ($p < 0.05$) from back players. (#) Statistically significant difference ($p < 0.05$) from back row players.

DISCUSSION

This study analyzed the physical fitness and anthropometric characteristics of young Brazilian rugby players, taking into account sex, age group, and playing position. The main findings of the study are as follows. In the sex analyses, male players exhibited greater height,

body mass, abdominal repetitions, horizontal jump performance, agility, and linear speed compared to female players, while female players demonstrated higher upper limb strength.

Regarding the age category analyses, youth athletes had greater body mass, height, BMI, horizontal jump test, agility, and linear speed than child players. Finally, the playing position analyses showed that front row players had greater body structure than back players and back row players. The backs were more agile and had higher upper limb strength scores than the front row players. They were also faster than both front row and back row players. The first finding relates to the effect of sex on test performance, with males performing better overall. These results do not differ from the study by Lesinski et al. (2020) with similar samples.

However, in our study, the female players showed higher upper limb strength than the male athletes, which may be somewhat unexpected and contradicts our first hypothesis. This result may have been influenced by the specificity of the evaluation protocols between male athletes (who performed the push-ups without their knees on the ground) and female athletes (who performed the push-ups with their knees on the ground). Another factor that may have influenced the results in this particular test is the fact that the execution is affected by the body weight of the athletes. Therefore, athletes who are lighter and have a higher percentage of lean body mass are likely to have an advantage in performing this test, making it a better assessment of relative strength.

Our second finding is consistent with the second hypothesis and is similar to the previous results, indicating that significantly higher body height and mass with increasing age is a natural process on the path from childhood to adolescence, despite the effect of maturity status (Lesinski et al., 2020). Motor development depends on and is influenced by growth and maturation, and consequently affects physical fitness (Malina et al., 2004).

In addition, older athletes were faster, more agile, and more powerful than younger players. However, no differences were found in the push-up and abdominal tests. As previously discussed, the influence of body weight on the performance of these tests may explain these findings. It is important to note that in the age group comparison, male and female athletes were compared in a single analysis, and due to the fact that females mature earlier than males, it is possible that if the groups had been divided by age and sex, we might have found different results.

Finally, the results regarding playing position are consistent with previous research (Dacres-Manning, 1998; Delahunt et al., 2013; Sedeaud et al., 2012), which shows that front row forward players are taller than back row forward players and back players, although the latter are overall faster and more agile than the former. An unexpected finding is that front row players performed the worst in the push-up tests compared to the back row and back players. Front row players are expected to be stronger than players in other positions groups, but it is important to note that because this particular test uses body weight, we can interpret that the measurement obtained is better for measuring absolute strength rather than relative strength.

These findings suggest a process of positional specialization among young players, based on their physical and anthropometric characteristics, to adapt them to the specific demands of each position. However, it is important to remember that the maturation status of the players can influence many variables, such as strength, speed, and body size. Therefore, coaches must be aware of the importance of having the athlete continue to explore different playing positions in the game to ensure the full development of the youngsters.

Despite the results follow an expected trend, it is important to compare our findings with other studies to understand how the Brazilian population of young players are placed in comparison

with players of other countries, although it is difficult to compare some of the results obtained in the present study with results from other studies for the difference in protocols or differences on the population.

When comparing the mean 20m linear speed performance for males (3.95 ± 0.33) in the present study with the results of a systematic review by Owen et al. (2020), which shows that the slowest time was observed in U16 school players (3.55 ± 0.22 s), U15 club level players (3.39 ± 0.10 s), and U17 players (3.02 ± 0.10 s) in the same test, we can conclude that the linear sprint performance of the young Brazilian players requires attention from coaches who need to prepare players for the high physical demands of the competition. The same happened when we compared the results of the 5-10-5 agility test, where the young men also had the worst performance (6.06 ± 0.43 s) compared to the U15 (5.34 ± 0.20 s), U17 (5.08 ± 0.18 s) and U19 (5.02 ± 0.35 s) players of a study by Kobal et al. (2016).

It is interesting to compare our data with the results of Kobal et al. (2016), as their study was also conducted with young Brazilian players of different categories, and it seems that players performed better in agility tests 8 years ago than today, which is worrying from a developmental point of view. It would be interesting to understand the reasons for this decline in performance over the years, with the aim of developing solutions to increase participation and performance in young rugby players.

This study has some limitations: a) anthropometric characteristics and physical fitness may not fully reflect the total demands of rugby matches; b) specific performance analysis for each playing position during competition could provide additional information on the role of anthropometric characteristics and physical fitness on athletic performance in youth and child rugby players; and c) research on anthropometric characteristics and physical fitness in rugby is still scarce, and there are still gaps in the literature, particularly in youth and child players.

In terms of the practical applicability of this study, it is a fact that rugby players must have well-developed physical and anthropometric qualities, due to the demanding nature of rugby (Emmonds et al., 2020). This highlights the relevance of this study as it provides some quantification of the anthropometric and physical characteristics of youth and child players, allowing for generalizable position-specific comparisons. Professionals in the field can use these values to analyze the strengths and weaknesses of their players, and the importance of anthropometric characteristics and physical fitness could be relevant in adapting and designing training programs to better match their abilities, improve performance and ultimately reduce the risk of injury.

CONCLUSIONS

This study analyzed the physical fitness and anthropometric characteristics of young Brazilian rugby players, taking into account sex, age group, and playing position. Overall, the results indicated that male players were taller, had higher body mass, and achieved better performance scores than female players. Older players also tended to be taller, heavier, stronger, more agile, and faster than younger players. In addition, front row players had higher body mass than back row and back players, who in turn had better physical scores in the agility, speed, and upper limb strength tests. Future research is warranted to examine physical fitness and anthropometric characteristics across multiple age groups (U13, U15, U17, and U19) to verify how these variables differ across the development of young rugby players.

REFERENCES

1. Barr, M., Sheppard, J., Gabbett, T., & Newton, R. (2014). Long-Term Training-Induced Changes in Sprinting Speed and Sprint Momentum in Elite Rugby Union Players. *Journal*

of Strength and Conditioning Research, 28(10), 2724-2731. https://doi.org/10.1519/JSC.0000000000000364
2. Cahill, N., Lamb, K., Worsfold, P., Headey, R., & Murray, S. (2013). The Movement Characteristics of English Premiership Rugby Union Players. *Journal of Sports Sciences, 31*(3), 229-237. https://doi.org/10.1080/02640414.2012.727456
3. Chiwaridzo, M., Mudawarima, T., Shumba, T. W., Ferguson, G. D., & Smits-Engelsman, B. C. (2024). A Comparative Analysis of Physical Fitness Characteristics and Rugby-Specific Game Skills of Schoolboy Players by Playing Standards: Implications for Talent Identification Programs in Resource-Constrained Settings. S*outh African Journal of Sports Medicine, 36*(1), 1-8. https://doi.org/10.17159/2078-516X/2024/v36i1a18525
4. Dacres-Manning, S. (1998). Anthropometry of the NSW Rugby Union 12 Team. Australian Conference of Science and Medicine in Sport (Ed), *Australian conference of science and medicine in sport* (94 p.). Adelaide: Sport Medicine Australia.
5. Delahunt, E., Byrne, R. B., Doolin, R. K., McInerney, R. G., Ruddock, C. T. J., & Green, B. S. (2013). Anthropometric Profile and Body Composition of Irish Adolescent Rugby Union Players Aged 16-18. *Journal of Strength and Conditioning Research, 27*(12), 3252-3258. https://doi.org/10.1519/JSC.0B013E3182915EA6
6. Deutsch, M. U., Kearney, G. A., & Rehrer, N. J. (2007). Time-Motion Analysis of Professional Rugby Union Players during Match-Play. *Journal of Sports Sciences, 25*(4), 461-472. https://doi.org/10.1080/02640410600631298
7. Dimundo, F., Cole, M., Blagrove, R., Till, K., Alexander, B. T., McAuley, A., Hall, M., Gale, C., & Kelly, A. L. (2021). Talent Identification and Development in Male Rugby Union: A Systematic Review. *Journal of Expertise, 4*(1), 33-55. https://www.journalofexpertise.org/articles/volume4_issue1/JoE_4_1_Dimundo_etal.html
8. Duthie, G., Pyne, D., & Hooper, S. (2003). Applied Physiology and Game Analysis of Rugby Union. *Sports Medicine, 33*(13), 973-991. https://doi.org/10.2165/00007256-200333130-00003
9. Emmonds, S., Weaving, D., Dalton-Barron, N., Rennie, G., Hunwicks, R., Tee, J., Owens, C., & Jones, B. (2020). Locomotor Characteristics of the Women's Inaugural Super Lea-

gue Competition and the Rugby League World Cup. *Journal of Sports Sciences, 38*(21), 2454-2461. https://doi.org/10.1080/02640414.2020.1790815
10. Engebretsen, L., & Steffen, K. (2010). Rugby in Rio in 2016! B*ritish Journal of Sports Medicine, 44*(3), 157. https://doi.org/10.1136/bjsm.2010.71555
11. Fontana, F. Y., Colosio, A., De Roia, G. F., Da Lozzo, G., & Pogliaghi, S. (2015). Anthropometrics of Italian Senior Male Rugby Union Players: From Elite to Second Division. *International Journal of Sports Physiology and Performance, 10*(6), 674-680. https://doi.org/10.1123/IJSPP.2015-0014
12. Fuller, C. W., Taylor, A., & Raftery, M. (2017). 2016 Rio Olympics: An Epidemiological Study of the Men's and Women's Rugby-7s Tournaments. *British Journal of Sports Medicine, 51*(17), 1272-1278. https://pubmed.ncbi.nlm.nih.gov/28137789/
13. Gabbett, T. J. (2005). Physiological and Anthropometric Characteristics of Junior rugby League Players over a Competitive Season. *Journal of Strength and Conditioning Research, 19*(4), 764-771. https://doi.org/10.1136/bjsports-2016-097301
14. Gaya, A. R., Gaya, A., Pedretti, A., & Mello, J. (2021). P*rojeto Esporte Brasil Manual de Medidas, Testes e Avaliações. Versão 2021*. http://hdl.handle.net/10183/217804
15. Guerriero, A., Schultz, F., Arenhart, I., & Ramos, M. (2020). *Manual de Testes Físicos: Brasil Rugby 2019-2023. Seleção Masculina 15s-7s, Seleção Feminina 15s-7s*. Confederação Brasileira de Rugby. https://brasilrugby.com.br/wp-content/uploads/2020/04/Manual-De-Testes-Brasil-Rugby-compactado.pdf
16. Gutierrez, D. M., Antonio, V. S. R., Kater, T., & de Almeida, M. A. B. (2017). A Study on the Introduction and Institucionalization of Rugby in Brazil. *Journal of Physical Education, 28*(1), e2841. https://doi.org/10.4025/JPHYSEDUC.V28I1.2841
17. Henderson, J. M., Harries, K. S., Poulos, N., Fransen, J., & Coutts, J. A. (2018). Rugby Sevens Match Demands and Measurement of Performance: A Review. *Kinesiology, 50*(1), 49-59. https://hrcak.srce.hr/ojs/index.php/kinesiology/article/view/6350
18. Jones, T. W., Keane, K., Smith, A., Dent, J., McShane, K., Payne, T., Williams, L., Maguire, P., Marshall, S. J., & Graham-Smith, P. (2019). Which Anthropometric and Lower Body

Power Variables are Predictive of Professional and Amateur Playing Status in male Rugby Union Players? I*nternational Journal of Sports Science and Coaching, 14*(1), 82-90. https://doi.org/10.1177/1747954118805956
19. Kobal, R., Nakamura, F. Y., Moraes, J. E., Coelho, M., Kitamura, K., Cal Abad, C. C., Pereira, L. A., & Loturco, I. (2016). Physical Performance of Brazilian Rugby Players from Different Age Categories and Competitive Levels. J*ournal of Strength & Conditioning Research, 30*(9), 2433-2439. https://doi.org/10.1519/JSC.0000000000001348
20. Lesinski, M., Schmelcher, A., Herz, M., Puta, C., Gabriel, H., Arampatzis, A., Laube, G., Büsch, D., & Granacher, U. (2020). Maturation-, Age-, and Sex-Specific Anthropometric and Physical Fitness Percentiles of German Elite Young Athletes. *PLoS ONE, 15*(8), e0237423. https://doi.org/10.1371/journal.pone.0237423
21. Lopes, A. L., Sant'ana, R. T., Baroni, B. M., Cunha, G. dos S., Radaelli, R., Oliveira, Á. R., & Castro, F. de S. (2011). Perfil antropométrico e fisiológico de atletas brasileiros de "rugby". *Revista Brasileira de Educação Física e Esporte, 25*(3), 387-395. https://doi.org/10.1590/S1807-55092011000300004
22. Malina, R. M., Bouchard, C., & Bar-Or, O. (2004). *Growth, Maturation, and Physical Activity*. Human Kinetics.
23. Mello, J. B., Nagorny, G. A. K., De Castro Haiachi, M., Gaya, A. R., & Gaya, A. C. A. (2016). Projeto Esporte Brasil: Physical Fitness Profile related to Sport Performance of Children and Adolescents. *Revista Brasileira de Cineantropometria & Desempenho Humano, 18*(6), 658-666. https://doi.org/10.5007/1980-0037.2016v18n6p658
24. Owen, C., Till, K., Darrall-Jones, J., & Jones, B. (2022). Statistical Analysis Considerations within Longitudinal Studies of Physical Qualities in Youth Athletes: A Qualitative Systematic Methodological Review. *PLoS ONE, 17*(7), 1-28. https://doi.org/10.1371/JOURNAL.PONE.0270336
25. Owen, C., Till, K., Weakley, J., & Jones, B. (2020). Testing Methods and Physical Qualities of Male Age Grade Rugby Union Players: A Systematic Review. *PLoS ONE, 15*(6), 1-37. https://doi.org/10.1371/JOURNAL.PONE.0233796

26. Pelicer, R., Nagamine, K. K., Faria, M. A., Freitas, V. de L., Neiva, C. M., Filho, D. M. P., Ciolac, E. G., & Verardi, C. E. L. (2016). Heath-Related Physical Fitness in School Children and Adolescents. *International Journal of Sports Science, 6*(1), 19-24. http://article.sapub.org/10.5923.s.sports.201601.04.html
27. Pino-Ortega, J., Rojas-Valverde, D., Gómez-Carmona, C. D., & Rico-González, M. (2021). Training Design, Performance Analysis, and Talent Identification-A Systematic Review about the Most Relevant Variables through the Principal Component Analysis in Soccer, Basketball, and Rugby. *International Journal of Environmental Research and Public Health, 18*(5), 1-18. https://doi.org/10.3390/IJERPH18052642
28. Quarrie, K. L., Handcock, P., Waller, A. E., Chalmers, D. J., Toomey, M. J., & Wilson, B. D. (1996). The New Zealand Rugby Injury and Performance Project (III). Anthropometric and Physical Performance Characteristics of Players. *British Journal of Sports Medicine, 29*(4), 263-270. http://article.sapub.org/10.5923.s.sports.201601.04.html
29. Rigg, P., & Reilly, T. (1988). A Fitness Profile and Anthropometric Analysis of First- and Second-Class Rugby Union Players. In T. Reilly, A. Lees, K. Davids, W. J. Murphy (Eds.), *Science and Football. Proceedings of the first World Congress of Science and Football. Liverpool, 13-17th April 1987* (pp. 194-200). Routledge. https://doi.org/10.4324/9780203720035
30. Ross, A., Gill, N., & Cronin, J. (2014). Match Analysis and Player Characteristics in Rugby Sevens. *Sports Medicine, 44*, 357-367. https://doi.org/10.1007/S40279-013-0123-0
31. Scantlebury, S., McCormack, S., Sawczuk, T., Emmonds, S., Collins, N., Beech, J., Ramírez, C., Owen, C., & Jones, B. (2022). The Anthropometric and Physical Qualities of Women's Rugby League Super League and International Players; Identifying Differences in Playing Position and Level. *PloS ONE, 17*(1), 1-13. https://doi.org/10.1371/Journal.pone.0249803
32. Sedeaud, A., Marc, A., Schipman, J., Tafflet, M., Hager, J. P., & Toussaint, J. F. (2012). How They won Rugby World Cup through Height, Mass and Collective Experience. *British Journal of Sports Medicine, 46*(8), 580-584. https://pubmed.ncbi.nlm.nih.gov/22348873/
33. Sella, F. S., McMaster, D. T., Beaven, C. M., Gill, N. D., &

Hebert-Losier, K. (2019). Match Demands, Anthropometric Characteristics, and Physical Qualities of Female Rugby Sevens Athletes: A Systematic Review. *Journal of Strength and Conditioning Research, 33*(12), 3463-3474. https://doi.org/10.1136/bjsports-2011-090506

34. Smart, D. J., Hopkins, W. G., & Gill, N. D. (2013). Differences and Changes in the Physical Characteristics of Professional and Amateur Rugby Union Players. *Journal of Strength and Conditioning Research, 27*(11), 3033-3044. https://doi.org/10.1519/JSC.0B013E31828C26D3
35. Tessutti, L. S., Aguiar, S. S., Costa, G. C. T., Clemente, F. M., Lima, R. F., Neves, R. V. P., Praça, G. M., & Castro, H. O. (2019). Body Composition and Performance Variables Differences in Female Volleyball Players by Agegroup and Playing Position. *Revista Brasileira de Cineantropometria & Desempenho Humano, 21*, e60131. https://doi.org/10.1590/1980-0037.2019V21E60131
36. Vaz, L., Vasilica, I., Carreras, D., Kraak, W., & Nakamura, F. Y. (2016). Physical Fitness Profiles of Elite Under-19 Rugby Union Players. *Journal of Sports Medicine and Physical Fitness, 56*(4), 415-421. https://pubmed.ncbi.nlm.nih.gov/25651896/
37. Woodhouse, L. N., Tallent, J., Patterson, S. D., & Waldron, M. (2022). International Female Rugby Union Players' Anthropometric and Physical Performance Characteristics: A Five-Year Longitudinal Analysis by Individual Positional Groups. J*ournal of Sports Sciences, 40*(4), 370-378. https://doi.org/10.1080/02640414.2021.1993656
38. World Rugby. (2023). A*dvanced Conditioning for Rugby (Pre-Level 2)*. https://passport.world.rugby/conditioning-for-rugby/advanced-conditioning-for-rugby-pre-level-2/
39. Yao, X., Curtis, C., Turner, A., Bishop, C., Austerberry, A., & Chavda, S. (2021). Anthropometric Profiles and Physical Characteristics in Competitive Female English Premiership Rugby Union Players. International Journal of Sports Physiology and Performance, 16(9), 1234-1241. https://doi.org/10.1123/IJSPP.2020-0017