

# Comparison of the anthropometric profiles of elite youth rugby union players

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## Summary

**Background:** Anthropometric evaluation of athletes is necessary to optimize talent identification and player development. The aim was to describe the anthropometric characteristics of national under-18 and under-20 rugby team by field positions in two seasons.

**Material and method:** 152 players of under-18 and under-20 rugby teams were measured for mass, stature, skinfolds, percentage body fat, skeletal muscle mass, bone mineral and somatotype between 2015-2016 and 2016-2017 seasons. Mean and standard deviation were calculated for each national team, groups and positional. The Mann-Whitney U test were performed to investigate differences between national team and by groups. The Kruskal-Wallis test was performed to investigate differences between positional.

**Results:** The forward units were heavier, taller and had a larger percentage body fat and skeletal muscle mass than back units ( $p < 0.05$ ). The props had a larger percentage body fat ( $p < 0.05$ ) and the second row were taller ( $p < 0.05$ ).

**Conclusions:** The elite players of under-20 in Spain are heavier and have a larger percentage body fat and skeletal muscle mass than elite players of under-18. The forward units are heavier, taller and have a larger percentage body fat, skeletal muscle mass and bone mineral than back units. The props are heavier positional and have larger percentage body fat. The second row are taller positional.

## Key words:

Anthropometric. Rugby. Body composition. Somatotype.

## Perfil antropométrico comparativo entre jugadores juveniles de rugby de élite

### Resumen

**Introducción:** La evaluación antropométrica de los deportistas es necesaria para optimizar la identificación y el desarrollo de los jugadores. Nuestro objetivo es describir las características antropométricas por posición en los jugadores de las selecciones de rugby XV Sub18 y Sub20 durante dos temporadas.

**Material y método:** A 152 jugadores de las selecciones de rugby XV Sub18 y Sub20 de España se les midió la estatura, masa corporal, pliegues cutáneos, porcentaje de tejido graso, masa muscular esquelética (MME), masa mineral ósea (MMO) y somatotipo durante las temporadas 2015-2016 y 2016-2017. Se calculó el promedio y la desviación estándar para cada selección, grupo y posición. Se realizó el análisis de U de Mann-Whitney para comparar entre selecciones y por grupos. Para comparar entre posiciones se utilizó la prueba de Kruskal-Wallis.

**Resultados:** Los jugadores agrupados como delanteros presentan mayor masa corporal, estatura, porcentaje de tejido graso, MME y MMO que los tres cuartos ( $p < 0,05$ ). Los jugadores que ocupan la posición de piliers presentan mayor porcentaje de tejido graso ( $p < 0,05$ ) y los que ocupan la posición de segunda línea son los de mayor estatura ( $p < 0,05$ ).

**Conclusiones:** Los jugadores de élite en España Sub20 presentan mayor masa corporal, porcentaje de tejido graso y MME que los jugadores élite de España Sub18. Los jugadores agrupados como delanteros de nivel élite en España Sub18 y Sub20 presentan mayor masa corporal, estatura, porcentaje de tejido graso, MME y MMO que los jugadores agrupados como tres cuartos. La posición con mayor masa corporal y porcentaje de tejido graso es la de piliers en los jugadores de élite de España en las categorías Sub18 y Sub20. Los jugadores de nivel élite que ocupan la posición de segundas líneas son los de mayor estatura en España en las categorías Sub18 y Sub20.

## Palabras clave:

Antropometría. Rugby. Composición corporal. Somatotipo.

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## Introduction

Fifteen-a-side rugby union is a contact sport played on a field between two teams. The nature of the modern game means that all the players need to be able to make intermittent high-intensity efforts during a match which involve sprinting, tackling and competing in rucks, mauls and scrums. Within each team, there are two distinct groups of players (forwards and backs), and each player is given a number which represents their precise position within each group<sup>1</sup>. In each group, the players perform tasks specific to their position during a match. The forwards wear the numbers<sup>1-8</sup>, and the backs wear the numbers<sup>9-15</sup>. The forwards are frequently involved in physical clashes with the members of the opposing team, securing possession of the ball in scrums, line-outs, rucks (contact situation in open play in which the ball is on the ground, and one or more players from each team close around it while remaining on their feet) and mauls (contact situation in open play that occurs when the ball carrier is held by an opponent and one or more of the ball carrier's team mates bind onto him/her)<sup>2-4</sup>. They need to be able to pass the ball in limited areas of the field when attacking. While the backs need to secure possession of the ball in tackles and rucks, their main role is to evade defenders while carrying it in wide open spaces on the field<sup>2-4</sup>. Based on this overview of the game, the forwards are slower and stronger than the backs, and the backs are faster and more agile<sup>5,6</sup>. The completely different roles played by the forwards and the backs would suggest the need for specific anthropometric profiles in order to develop effective and safe skills during games<sup>7</sup>.

The morphology of rugby players has changed over the last century. In the last 25 years, their mean body mass has increased at a rate three to four times greater than in the previous 75 years<sup>8</sup>, with taller backs and heavier forwards<sup>9</sup>. In rugby, high body mass is usually a predictor of success<sup>8</sup>. During the static phases focussing on ball retention, high body mass (regardless of composition) is an advantage because it represents an external load that the other team has to try to move in scrums. During the dynamic phases of a game, however, the determining factor of play is the ability to accelerate and decelerate, along with a player's power to body mass ratio (which is always influenced by body composition)<sup>10</sup>. High relative fat mass is associated with high energy expenditure<sup>1,11</sup>, which leads to a greater risk of traumas and overuse injuries when the physical characteristics of the athlete are not optimal for the role their position dictates<sup>12</sup>. In conclusion, high body mass *per se* is an advantage in the static phases of the game, which are more common at low competitive levels. However, a specific relationship between lean body mass and fat mass is needed in most of the dynamic actions which characterise modern rugby and, consequently, is also required to achieve optimum performance<sup>13,14</sup>. An anthropometric assessment of players by gender, position and age may provide an evaluation that could improve talent identification, training methodologies, injury-prevention strategies and monitoring of changes in body composition over the season<sup>1,15</sup>.

Body composition data are limited for fifteen-a-side rugby<sup>4</sup>, few studies existing to date which provide anthropometric data for younger players by position. Due to the different physical demands that players in different positions face<sup>1,2</sup>, a comparative anthropometric study of Spanish youth-level rugby players by position is needed, this being the first study to provide such data.

We aim to describe the anthropometric characteristics of the Spain U18 and U20 international rugby squads by position over two seasons.

## Materials and methods

The players in the Spain men's international rugby squads in the U18 and U20 categories were studied in the 2015-2016 and 2016-2017 seasons. Assessment was carried out at each squad's training camp each season. All the participants and/or their legal guardians were informed about the purpose of the study and gave their written consent to participate. The study complied with the Declaration of Helsinki for research involving human subjects and was approved by the Ethics Committee at the Clinical Hospital of the Complutense University of Madrid.

### Subjects

A total of 152 different players were studied in the 2015/2016/2017 seasons, conducting a total of 166 assessments, 14 players repeating in the two squads in the seasons studied. Sixty-six belonged to the U18 category and one hundred to the U20 category. The players were divided into two groups: forwards and backs. They were also subdivided into 9 subgroups according to their positions on the field: props, hookers, second row, back row, scrum-halves, fly-halves, centres, wings and full-backs.

### Anthropometry

Body mass and height were measured on the first day of the training camp before breakfast, with the players only wearing shorts. Body mass was measured with a digital scale (Seca 877, Seca, Leicester, UK) and height with a wall-mountable height rod (Seca 206, Seca, Leicester, UK). The skinfolds, circumferences and diameters of all the players were measured by the same researcher. A total of eight folds (biceps, triceps, subscapular, suprailiac, supraspinal, abdominal, front thigh and medial calf) were measured three times with a manual caliper (Innovare 4 Cescorf, Porto Alegre, Br). In the same session, three bone diameters (medial epicondyle of the humerus to the lateral epicondyle, radial styloid process to the ulnar styloid process and medial condyle of the femur to the lateral condyle) were measured with a pachymeter (Cescorf, Porto Alegre, Br) and 4 muscle circumferences (arm relaxed, arm flexed, mid-thigh and calf) with a tape measure (Cescorf, Porto Alegre, Br).

The mean was calculated for each fold (after eliminating any possible outliers in the event of a difference greater than 1 mm). The sum of 8 folds was obtained. Body mass index (BMI), body fat percentage

(Carter equation<sup>16</sup>), skeletal muscle mass (Lee equation<sup>17</sup>) and bone mineral mass (Rocha equation<sup>18</sup>) were also calculated. Somatotyping was performed using the Heath-Carter method<sup>19</sup>.

**Statistics**

The mean and standard deviation, with a confidence interval of 95%, were calculated for each squad, group (forwards and backs) and position (props, hookers, second row, back row, scrum-halves, fly-halves, centres, wings and full-backs). The methodology proposed by Heath-Carter was used for somatotyping, using the somatotype dispersion index (SDI), the mean somatotype dispersion distance (SDD) and the somatotype attitudinal mean (SAM)<sup>19</sup>. Prior to analysis of the data, the Kolmogorov-Smirnov test was used to evaluate normal distribution; non-parametric statistics was used to analyse data without normal distribution. The Mann-Whitney U test was applied to compare by squad and by group. The Kruskal-Wallis test was used to compare by position. Comparison with other studies was performed with the independent samples *t* test and the somatotypes were compared with SDD. Data analysis was performed using SPSS for Windows version 20.

**Results**

Table 1 shows the descriptive values of anthropometric measurements obtained by category (U18 and U20), Table 2 the values obtained by field position (forwards and backs), and Tables 3 and 4 the values obtained for each field position by team category.

**Comparison between categories (U18 and U20)**

*Height:* Comparing each squad by group (Table 3) shows that there is no significant difference in height between the forwards in the two squads, the U18 forwards measuring 1.83±0.07 m and the U20 players measuring 1.84±0.06 m. The same occurs with the backs (Table 4), where the height in the U18 squad is 1.79±0.06 m, while in the U20 squad it is 1.79±0.05 m. However, when the forwards are compared with the backs (Table 2), differences are observed (*p* <0.005).

*Body mass:* In relation to body mass and BMI, there are significant differences between the forwards in the two squads, the U18 players

**Table 1. Anthropometric values by team category.**

	U18 squad (n=66)	U20 squad (n=100)	p
Weight	86.6 ±11.7	93.2±16.2	0.016*
Height	1.81±0.07	1.82±0.06	0.305
BMI	26.25±3.1	28.02±4.3	0.012*
BF	10.43±3.6	12.62±4.8	0.01*

BMI: Body mass index; BF: Body fat; p: U Mann-Whitney p-value; \*statistically significant difference: p<0.05.

**Table 2. Comparison of anthropometric variables by group of players.**

		Forwards (n: 95)	Backs (n: 71)	P
Weight	95% CI	98.9±13.6	79.5±7.5	0.000**
		96.16-101.71	77.75-81.30	
Height	95% CI	1.83±0.06	1.79±0.06	0.000**
		1.82-1.85	1.77-1.80	
BMI	95% CI	29.2±4.0	24.7±1.9	0.000**
		28.44-30.10	24.25-25.18	
% body fat	95% CI	13.6±4.8	9.1±2.1	0.000**
		12.68-14.65	8.68-9.69	
Σ 8 folds	95% CI	135.7±57.6	80.9±27.1	0.000**
		124.03-147.51	74.54-87.38	
SMM	95% CI	33.8±3.1	30.4±2.7	0.000**
		33.22-34.50	29.78-31.08	
BMM	95% CI	13.6±1.3	12.4±1.1	0.000**
		13.38-13.93	12.17-12.71	
<b>Somatotype</b>				
Endomorphic	95% CI	4.4±1.8	2.6±0.9	0.000**
		4.03-4.81	2.42-2.87	
Mesomorphic	95% CI	4.7±1.1	4.1±0.9	0.000**
		4.52-4.99	3.90-4.35	
Ectomorphic	95% CI	0.9±0.7	1.7±0.5	0.000**
		0.83-1.12	1.56-1.84	
SDI		2.19*	1.69	
SDD		4.43*		
SAM		2		

BMI: Body mass index; BF: Body fat; Σ8 folds: Sum of 8 folds; SMM: Skeletal muscle mass; BMM: Bone mineral mass; SDI: Somatotype dispersion index; SDD: Mean somatotype dispersion distance; SAM: Somatotype attitudinal mean; CI: confidence interval 95%; p: Mann-Whitney test p-value. The asterisks indicate statistically significant differences: \*p<0.05; \*\*p<0.01, respectively.

giving lower figures of 93.2±10.0 kg and 27.8±2.9 kg/m<sup>2</sup>, and the U20 players higher figures of 102.3±14.4 kg and 30.1±4.4 kg/m<sup>2</sup> (*p* <0.05). No significant differences are observed between the backs in the two squads. Comparing the forwards and the backs, the weight and BMI of the forwards are greater, with 98.9±13.6 kg and 29.2±4.0 kg/m<sup>2</sup>, while those of the backs are lower, with respective values of 79.5±7.5 kg and 24.7±1.9 kg/m<sup>2</sup> (*p* <0.05).

*Body fat percentage:* There are differences in body fat percentage, sum of the 8 folds and skeletal muscle mass between the forwards in the two squads and between the backs in the two squads, the values for U20 players being higher (*p* <0.05). Comparing forwards with backs, higher values are observed in the forwards (*p* <0.05).

*Somatotype:* Regarding somatotypes, it is observed that that of the forwards is heterogeneous, with an SDI of more than 2, while that of the

**Table 3. Comparison of anthropometric variables in forwards by squad.**

	Forwards U18 (n:36)	Forwards U20 (n:59)	p
Weight	93.2±10.0	102.3±14.4	0.002**
Height	1.83±0.07	1.84±0.06	0.1
BMI	27.8±2.9	30.1±4.4	0.009**
% body fat	12.0±3.7	14.6±5.1	0.007**
Σ 8 folds	114.8±45.5	148.5±60.7	0.003**
SMM	32.6±2.8	34.5±3.0	0.004**
BMM	13.5±0.2	13.7±0.17	0.32
Somatotype			
Endomorphic	3.8±1.5	4.7±2.0	0.02*
Mesomorphic	5.3±1.3	6.0±1.2	0.07
Ectomorphic	1.1±0.7	0.8±0.6	0.13
SDI	2.33*	2.02*	
SDD		2.21*	
SAM		1.18	

BMI: Body mass index; BF: Body fat; Σ8 folds: Sum of 8 folds; SMM: Skeletal muscle mass; BMM: Bone mineral mass; SDI: Somatotype dispersion index; SDD: Mean somatotype dispersion distance; SAM: Somatotype attitudinal mean; p: Mann-Whitney test p-value; The asterisks indicate statistically significant differences: \*p<0.05; \*\*p<0.01, respectively.

**Table 4. Comparison of anthropometric variables in backs by squad.**

	Backs U18 (n:30)	Backs U20 (n:41)	p
Weight	78.7±8.2	80.0±6.9	0.177
Height	1.79±0.06	1.79±0.05	0.7
BMI	24.3±2.2	24.9±1.7	0.08
% body fat	8.5±2.2	9.6±1.9	0.005**
Σ 8 folds	70.1±27.7	88.8±23.9	0.001**
SMM	30.4±3.0	30.3±2.5	0.954
BMM	12.6±0.2	12.3±0.15	0.34
Somatotype			
Endomorphic	2.4±1.0	2.8±0.8	0.0001**
Mesomorphic	4.0±0.9	4.1±0.9	0.609
Ectomorphic	1.8±0.6	1.6±0.5	0.141
SDI	1.68	1.61	
SDD		3.11*	
SAM		0.43	

BMI: Body mass index; BF: Body fat; Σ8 folds: Sum of 8 folds; SMM: Skeletal muscle mass; BMM: Bone mineral mass; SDI: Somatotype dispersion index; SDD: Mean somatotype dispersion distance; SAM: Somatotype attitudinal mean; p: Mann-Whitney test p-value; The asterisks indicate statistically significant differences: \*p<0.05; \*\*p<0.01, respectively.

**Table 5. Comparison of anthropometric variables by position of players.**

	Prop N:31	Hooker N:12	Second row N:23	Back row N:29	Scrum-half N:12	Fly-half N:11	Centre N:19	Wing N:21	Full-back N:8
U18	9	8	11	8	5	6	8	7	4
U20	22	4	12	21	7	5	13	12	4
Weight (kg)	112.5±11.2 <sup>‡‡‡#μ</sup> (CI:108.4-116.7)	88.1±4.3 <sup>^‡</sup> (CI:85.3-90.8)	96.8±10.8 <sup>‡‡#μ</sup> (CI:92.1-101.5)	90.5±7.2 <sup>^‡#μ</sup> (CI:87.7-93.2)	71.4±5.8 <sup>^‡‡‡</sup> (CI:67.7-75.1)	78.9±4.1 <sup>^‡‡</sup> (CI:76.1-81.7)	84.1±7.8 <sup>^‡‡</sup> (CI:80.5-87.7)	79.5±6.8 <sup>^‡‡</sup> (CI:76.2-82.7)	80.3±3.7 <sup>^‡</sup> (CI:77.2-83.4)
Height (m)	1.82±0.06 <sup>‡‡</sup> (CI:1.79-1.84)	1.77±0.04 <sup>‡</sup> (CI:1.74-1.79)	1.90±0.05 <sup>^‡‡#μ</sup> (CI:1.87-1.92)	1.83±0.05 <sup>‡</sup> (CI:1.81-1.85)	1.72±0.03 <sup>^‡‡#μ</sup> (CI:1.69-1.74)	1.77±0.04 <sup>‡</sup> (CI:1.73-1.80)	1.82±0.04 <sup>‡‡</sup> (CI:1.80-1.84)	1.81±0.05 <sup>‡‡</sup> (CI:1.78-1.83)	1.81±0.06 <sup>‡</sup> (CI:1.75-1.86)
BF (%)	19.0±3.9 <sup>‡‡‡#μ</sup> (CI:17.6-20.5)	11.5±2.0 (CI:10.2-12.8)	11.2±2.7 <sup>^</sup> (CI:10.0-12.4)	10.6±2.2 <sup>^</sup> (CI:9.7-11.5)	9.2±2.2 <sup>^</sup> (CI:7.7-10.6)	8.8±2.7 <sup>^</sup> (CI:6.9-10.6)	9.5±2.1 <sup>^</sup> (CI:8.5-10.4)	8.7±1.6 <sup>^</sup> (CI:7.9-9.5)	9.8±2.2 <sup>^</sup> (CI:8.0-11.7)

BF: Body fat; CI: Confidence interval 95%; ^: Different to prop; \*: Different to hooker; ‡: Different to second row; §: Different to back row; ‡: Different to scrum-half; #: Different to fly-half; &: Different to centre; μ: Different to wing; ¶: Different to full-back.

backs is homogeneous, with an SDI below 2. The mean somatotype is different between forwards and backs (SDD > 2), between the forwards in the two squads (SDD > 2) and between the backs (SDD > 2). Endomorphism is significantly different between the forwards in the two squads and between the backs in the two squads (p < 0.05). However, there are no significant differences when the two squads are compared by groups in terms of mesomorphism and ectomorphism. Significant differences are noted when forwards are compared with backs, endomorphism

and mesomorphism being higher in the forwards, and ectomorphism being higher in the backs (Figure 1).

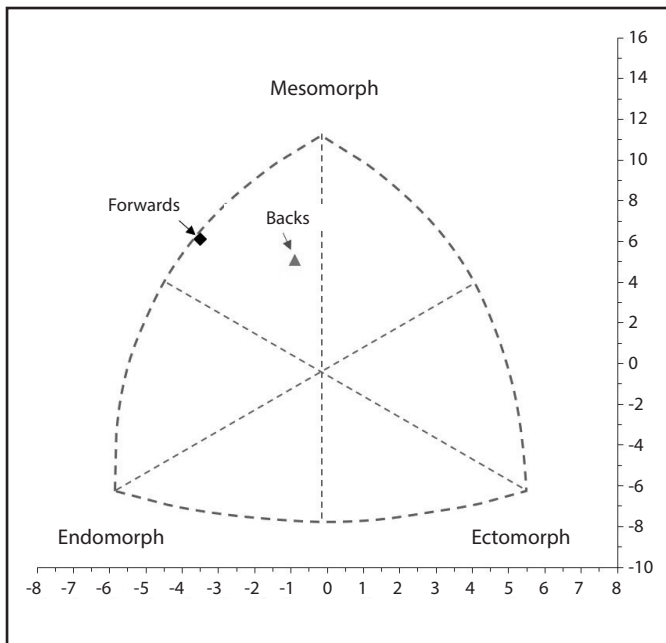
*Position:* The comparison by position is shown in Table 5. The body mass of the props is greater compared to other positions, with the sole exception of the second row, with whom no significant difference is observed. As for height, players in the second row are taller than those in other positions, save the third row and the full-backs, with whom no significant difference is observed. The body fat percentage is seen

**Table 6. Comparison of somatotype by position of players.**

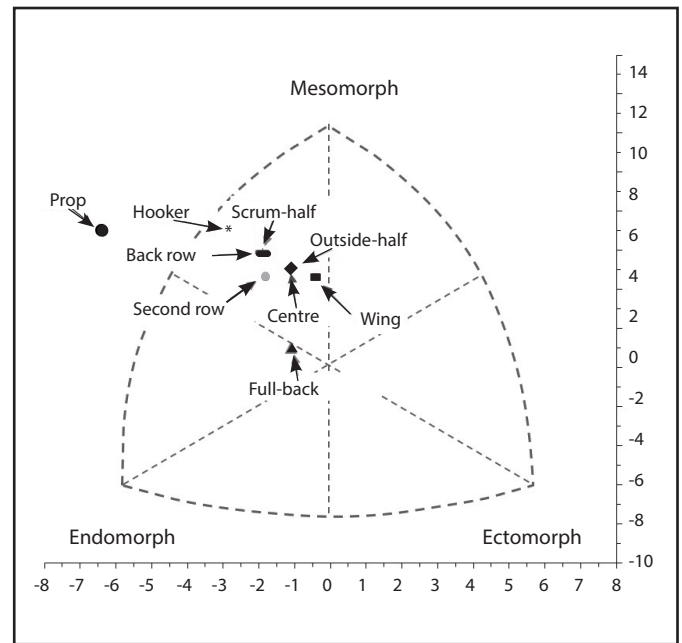
	Prop N:31	Hooker N:12	Second row N:23	Back row N:29	Scrum-half N:12	Fly-half N:11	Centre N:19	Wing N:21	Full-back N:8
U18	9	8	11	8	5	6	8	7	4
U20 22	4	12	21	7	5	13	12	4	
<b>Somatotype</b>									
Endomorphic	6.6±1.3 <sup>‡‡‡‡‡‡‡‡‡‡‡‡</sup> (CI:6.1-7.1)	3.7±0.8 <sup>μ</sup> (CI:3.2-4.3)	3.3±1.0 <sup>^</sup> (CI:2.8-3.7)	3.2±0.9 <sup>^</sup> (CI:2.9-3.5)	2.8±0.9 <sup>^</sup> (CI:2.3-3.4)	2.5±1.2 <sup>^</sup> (CI:1.6-3.4)	2.7±0.8 <sup>^</sup> (CI:2.3-3.1)	2.3±0.7 <sup>^</sup> (CI:1.9-2.6)	2.9±1.0 <sup>^</sup> (CI:2.0-3.7)
Mesomorphic	6.9±0.9 <sup>‡‡‡‡‡‡‡‡‡‡‡‡</sup> (CI:6.6-7.3)	5.8±0.8 (CI:5.3-6.3)	4.7±1.1 <sup>^</sup> (CI:4.2-5.2)	5.2±0.8 <sup>^</sup> (CI:4.9-5.6)	4.9±0.8 <sup>^</sup> (CI:4.4-5.5)	5.3±0.6 <sup>^</sup> (CI:4.9-5.7)	4.7±1.0 <sup>^</sup> (CI:4.3-5.2)	4.4±1.1 <sup>^</sup> (CI:3.8-5.0)	4.5±0.7 <sup>^</sup> (CI:3.9-5.1)
Ectomorphic	0.2±0.3 <sup>‡‡‡‡‡‡‡‡‡‡‡‡</sup> (CI:0.1-0.3)	0.8±0.4 <sup>μ</sup> (CI:0.5-1.1)	1.5±0.5 <sup>^</sup> (CI:1.3-1.7)	1.3±0.4 <sup>^</sup> (CI:1.1-1.5)	1.6±0.4 <sup>^</sup> (CI:1.3-1.9)	1.4±0.4 <sup>^</sup> (CI:1.1-1.8)	1.6±0.6 <sup>^</sup> (CI:1.3-1.9)	1.9±0.5 <sup>^</sup> (CI:1.6-2.1)	1.8±0.8 <sup>^</sup> (CI:1.0-2.5)

CI: Confidence interval 95%; ^: Different to prop; \*: Different to hooker; †: Different to second row; §: Different to back row; ‡: Different to scrum-half; #: Different to fly-half; &: Different to centre; μ: Different to wing; ¶: Different to full-back.

**Figure 1. Somatochart by group of players.**



**Figure 2. Somatochart by position of players.**



to be higher in the props when compared with other positions, with the exception of the hookers, with whom no significant difference is observed. The somatotype by position is shown in Table 6 and Figure 2.

### Discussion

This is the first study focussing on the anthropometric profile of the U18 and U20 international fifteen-a-side rugby squads in Spain. The information obtained in this study is limited by only centring on the elite fifteen-a-side rugby population aged from 17 to 20. However, because

they are the first data obtained, they will reveal physical aspects of rugby players in this age group in Spain which could help improve talent identification, training methodologies, injury-prevention strategies and the monitoring of variations in body composition during the season<sup>1,15</sup>.

This study shows that the U18 and U20 international rugby squads are of similar height, which is consistent with other research which observed no significant differences between the U18 and U20 categories in rugby<sup>20-22</sup>. However, body mass is greater in the U20 squad, a result which coincides with studies at rugby academies in the United Kingdom, where they observed greater body mass in under-20s compared

to under-18s<sup>20-22</sup>. The body fat percentage and the sum of folds are also higher in the U20 squad, but this differs from other studies that have shown that the sum of folds is similar at these ages<sup>20-22</sup>. That the U18 and U20 players are of similar height can be explained by the fact that only minimal changes in height are expected after the age of 18, and most of the players will have almost reached adult height by this point in their lives. By contrast, body mass would be expected to continue to rise with the intensification of the demands of competition and training (intensification of strength training programmes)<sup>4</sup>. The higher body fat percentage and sum of folds in the U20 squad is striking. This can be explained by the desire to increase body mass because this has been shown to increase linear momentum in tackling and physical collision<sup>4</sup>. A study focusing on rugby league also suggests that increasing the folds can protect players against the high number of collisions experienced in the sport<sup>23</sup>. Although an association between a low body fat percentage and enhanced performance has been demonstrated<sup>4, 24, 25</sup>, this can be explained by decreased acceleration on vertical and horizontal planes when the body fat percentage rises.

The difference in body mass, height, body fat percentage, sum of folds, skeletal muscle mass and somatotype between forwards and backs observed in this study is consistent with others, in both teenage<sup>7, 26-28</sup> and adult<sup>4, 29</sup> rugby players. The data on the mean body mass of U18 players given in the few studies published to date are not uniform. The mean results from this study are similar to those observed in U18 players in South Africa<sup>30</sup>, which gave 94.2±8.5 kg for forwards and 77.8±8.8 kg for backs ( $p = 0.66$ ), but greater than the study conducted with players of a similar age in Ireland ( $p < 0.05$ ), in which the forwards weighed 83.6±10.5 kg and the backs 73.6±6.6 kg<sup>7</sup>.

The height of the U18 forwards observed in this study is similar ( $p = 0.48$ ) to the heights seen in other studies focusing on players of a similar age, with forwards measuring 1.82±0.07 m and backs 1.78±0.05 m<sup>7</sup>. The comparison of the body fat percentage in the U18 forwards and backs is smaller ( $p < 0.05$ ) than what can be observed in other studies of players of the same age, which show 18% and 14%, respectively<sup>7, 30</sup>. Somatotyping the forwards and backs in the U18 squad, differences ( $SDD > 2$ ) can be observed when compared with the results of a study conducted with players in New Zealand<sup>28</sup>. In the forwards, mesomorphism is predominant over endomorphism, and both are predominant over ectomorphism, with slightly lower mesomorphism values than the aforementioned study of players of a similar age, which cited 5.6, and slightly higher endomorphism values than the same study, which found 3.428. Meanwhile, in the backs, mesomorphism is predominant over both endomorphism and ectomorphism, but the values are lower in mesomorphism and ectomorphism compared to the aforementioned study of players of a similar age, which indicated 5.5 and 2.3, while endomorphism gave a slightly higher figure than the New Zealand study, which cites 2.228. In the U20 forwards and backs, a greater body mass is observed ( $p < 0.05$ ) compared with studies of players of a similar age<sup>26, 27</sup> but a lower body mass when compared

with top-flight adult players, which stands at 108±8kg in forwards and 94±8kg in backs<sup>4</sup>. The U20 forwards and backs in this study are taller ( $p < 0.05$ ) than those of a similar age in other studies, in which the forwards measured 1.80±0.04 and the backs 1.77±0.03 m<sup>26</sup>, but of a similar height to the adult players measured in a study in Spain, in which the forwards stood at 1.82±0.07 m and the backs at 1.79±0.09 m<sup>31</sup>. Meanwhile, the body fat percentage found in the U20 forwards and backs is similar to that of adult international players<sup>4</sup> but lower than that found in adult players in Spain<sup>31</sup>. Somatotyping the forwards and backs in the U20 squad, differences ( $SDD > 2$ ) can be observed when compared with the results of a previous study conducted with players of the same age<sup>28</sup>. Mesomorphism is predominant in the forwards, the results being similar to another study with players of the same age, which gave 5.9, but the present study shows greater endomorphism than that same study, which indicated 3.628. Although mesomorphism predominates in the somatotype values of the U20 backs, it is lower than the value of 5.4 observed in players of a similar age, while endomorphism is higher than the study in New Zealand, which stood at 2.428. The differences observed between forwards and backs can be explained by the roles of each group in the game. The forwards are frequently involved in physical confrontation, which includes actions such as tackling, competing in scrums and rucking, and body mass and height are factors positively correlated with success during play<sup>32</sup>. The backs need to gain ground carrying the ball and score points by running through open space, and are typically involved in actions such as repeated high-speed sprints and shows of skill<sup>33</sup>.

In this study, the players are categorised into 9 positions. Comparisons show that the body mass of props is greater than that of other positions, with a mean which is higher ( $p < 0.05$ ) than a study of Argentinean adults, which showed a body mass of 105±10 kg<sup>34</sup>, but similar ( $p = 0.22$ ) to that of Italian adult internationals, which stood at 116±6 kg<sup>29</sup>. The greater body mass of props is understandable because they are the driving force in scrums and are constantly involved in rucks, mauls and tackles. The second-row forwards are taller, being similar in height ( $p = 0.5$ ) to the adult players who competed in a national tournament in Argentina, who measured 1.89 ± 0.04 m<sup>34</sup>, and slightly shorter ( $p < 0.05$ ) than the subjects in a study of adult international players, who were 1.97 ± 0.02 m<sup>29</sup>. The second-row forwards are usually the tallest players because they are the ones who jump the most at lineouts and try to gain possession of the ball at kick-off. The props show the highest body fat percentage, similar ( $p = 0.35$ ) to the 20±3% observed in adult internationals<sup>29</sup>. This higher body fat percentage can be explained by the demands of the position, and the objective is to absorb impact in collisions and tackles. In terms of somatotype, the props show greater endomorphism, although the somatotype is different from that observed in adult players ( $SDD > 2$ ), with greater endomorphism ( $p < 0.05$ ) than that observed in other studies with adults: 4.9±1.134. The props also show greater mesomorphism, although the values are lower ( $p < 0.05$ ) than those obtained in a study with adult players, which indi-



cated  $8.1 \pm 0.234$ . These results reflect the specific requirements of the position: high bone and muscle mass for scrums<sup>35</sup>.

Study and analysis in recent years has shown that the anthropometric profile is a key determinant for success in high-level rugby<sup>36</sup>. Therefore, the information obtained in this study needs to be added to the tactical, physical and psychological characteristics related to the specific demands of the game.

## Conclusions

The elite rugby players in the Spain U20 squad have a greater body mass, body fat percentage and skeletal muscle mass than their U18 counterparts.

The elite rugby players in the Spain U18 and U20 squads are of similar height.

The elite forwards in the Spain U18 and U20 rugby squads have a greater body mass, height, body fat percentage, skeletal muscle mass and bone mineral mass than the players in the backs group.

The props are the position with the greatest body mass and body fat percentage in the Spain U18 and U20 elite rugby categories.

The second-row forwards are the position with the tallest players in the Spain U18 and U20 elite rugby categories.

The data obtained will help us create normative values for talent identification, training guidelines, dietary interventions and the control of performance improvements.

## Study limitations

Other factors can also influence body composition besides training and competitive games, such as diet and activity outside competitive games and training. Although the players followed similar dietary and training guidelines, it would be impossible to control these variables, and we do not know what influence they may have on body composition and the differences between categories.

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## Conflict of Interests

The authors declare that they are not subject to any type of conflict of interest.

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