Anthropometric characteristics and somatotype profile in *amateur* rugby players

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Summary

Introduction: It has been proposed that body composition plays an essential role in sport performance. However, there are few studies that have analyzed body composition in amateur rugby players.
Objective: The purpose of the present study was to examine the anthropometric characteristics, somatotype profile, fat and muscle components in rugby players from an amateur Spanish team.
Material and method: Height, body mass, diameters, perimeters and skinfolds from thirty-one rugby players were measured. Fat and muscle components and somatotype profile were determined. Proportionality was determined with the z-phantom strategy. Descriptive statics (mean ± SD) and *t*-student were used.
Results: Mean body mass was 85.32 ± 14.36 kg, mean fat mass percentage was 12.35 ± 3.46%, mean muscle mass percentage was 50.29 ± 7.74% and mean somatotype was 4.50-5.80-0.95. The sum of six skinfolds was 92.92 ± 32.95 mm. Significant differences were observed between forwards and backs in body mass (95.24 *vs* 77.15 kg; p<0.001), in sum of six skinfolds (107.67 *vs* 80.77 mm; p=0.021), in body fat percentage (13.90 *vs* 11.07%; p=0.021), in muscle mass percentage (45.16 *vs* 54.54%; p=<0.001) in endomorphy (5.31 *vs* 3.76; p=0.013) and in ectomorphy (0.62 *vs* 1.33; p=0.002). Regarding proportionality, differences were found in function on the position in on the field.
Conclusion: Anthropometrical measures would be an adequate instrument to evaluate body composition in rugby. Anthropometric profile in rugby could be related to the specific position the field, although further studies would be necessary to confirm this idea. The level of professionalism could affect to the anthropometrics characteristics in rugby players.

Key words:
Muscle. Fat. Anthropometry. Body composition. Somatotype.

Características antropométricas y somatotipo en jugadores *amateur* de rugby

Resumen

Introducción: Se ha propuesto que la composición corporal juega un papel esencial en el rendimiento deportivo. Sin embargo, hay pocos estudios que hayan analizado la composición corporal en jugadores amateurs de rugby.
Objetivo: El objetivo del presente estudio fue examinar las características antropométricas, el somatotipo, el compartimento muscular y de grasa en jugadores amateurs de rugby de nacionalidad española.
Material y método: Se midió la altura, el peso, los diámetros, los perímetros y los pliegues corporales de treinta y un jugadores. Se analizó los componentes de grasa y músculo y el somatotipo. Se determinó la proporcionalidad con el z-phantom. Se utilizaron métodos estadísticos descriptivos (mean ± SD) y *t*-student.
Resultados: El peso medio fue 85,32 ± 14,36 kg, el porcentaje de grasa medio fue 12,35 ± 3,46%, el porcentaje medio de masa muscular fue 50,29 ± 7,74% y el somatotipo medio fue 4,50-5,80-0,95. La suma de los seis pliegues corporales fue 92,92 ± 32,95 mm. Se observaron diferencias entre jugadores de ataque y defensa en el peso (95,24 *vs* 77,15 kg; p<0,001), en la suma de los seis pliegues corporales (107,67 *vs* 80,77 mm; p=0,021), en el porcentaje de grasa corporal (13,90 *vs* 11,07%; p=0,021), en el porcentaje de masa muscular (45,16 *vs* 54,54%; p=<0,001) en la endomorfia (5,31 *vs* 3,76; p=0,013) y en la ectomorfia (0,62 *vs* 1,33; p=0,002). En cuanto a la proporcionalidad, se observaron diferencias en función de la posición de los jugadores en el campo.
Conclusión: Las medidas antropométricas serían un adecuado instrumento para evaluar la composición corporal en rugby. El perfil antropométrico en rugby podría estar relacionado con la posición ocupada en el campo de juego, aunque serían necesario más estudios para confirmar esta idea. El nivel de profesionalismo podría afectar a las características antropométricas de los jugadores de rugby.

Palabras clave:
Músculo. Grasa. Antropometría. Composición corporal. Somatotipo.

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Introduction

It has been well described that body composition plays a crucial role in sport performance[1]. Consequently, several methods have been used to study body composition in sports such as anthropometric analysis[2], bioelectrical impedance[3] or dual X-ray absorptiometry[4].

In particular, anthropometry determines the size, the proportionality, the composition, the form and the body function in athletes. Anthropometry relates body measures of form, proportions and compositions with specific function in sport[5]. Measures included in anthropometric analyses are body mass, height, wingspan, skinfolds, perimeters, diameters and lengths. From these data, it is possible to study body fat mass, body composition and somatotype[6]. Somatotype determines body composition in athletes which can be classified in three categories mesomorphy (related to muscle mass), endomorphy (related to fatness) and ectomorphy (related to linearity and slenderness)[7].

In rugby, anthropometry has been used more in recent years to analyze the physical status of players. Firstly, a paper[8] investigated the role of anthropometric qualities in team selection where skinfold thickness was a significant factor to discriminate between selected and non-selected players showing that anthropometrical characteristics could affect team selection for professional players. Another research[9] studied the possible relationship among physiological, anthropometric, skill characteristics and playing performance in rugby. Players with greater body mass and skinfold thickness played fewer minutes. Higher skinfold thickness was related to fewer tackle attempts, completed tackles, dominant tackles and a lower tackling efficiency. Anthropometrics characteristics could represent a crucial point in rugby performance. Another investigation[10] analyzed anthropometric profile in rugby players from Croatia. Comparing the results with data from high level players, backs and forwards players showed a higher body fat percentage, all players were more endomorphic, and forwards were less mesomorphic. The popularity of rugby and the degree of professionalism could affect to anthropometric characteristics. Additionally, another study[11] demonstrated that level of professionalism could have effects in anthropometrical characteristics in rugby. Although, this idea has not been completely demonstrated yet.

Rugby players have been examined in order to identify different anthropometric characteristics among playing position. A study[12] found that props were taller, heavier and presented a higher skinfolds thickness than the rest. Another research[13] analyzed sub-elite rugby players, props were heavier, taller and exhibited a higher sum of skinfolds. Furthermore, it seems that anthropometrical profile could differ in function of position on the field, despite this theory has not been totally validated yet.

The objectives of the current study were to explore the anthropometric characteristics, body composition and somatotype profile of rugby players from an amateur Spanish team.

Material and method

Participants

A total of thirty-one senior's male players from an amateur Spanish rugby team voluntary participated. Players were regularly involved in competitive trainings and matches, and they had not suffered important previous injuries. Players were aged 22.86 ± 3.31 years old. Participants have at least two years of experience in rugby. The distribution in different positions in on the field was prop (n = 3), hooker (n = 2), second row (n = 4), lock or flanker (n = 5), half-back (n = 3), five-eight or fly half (n=3), centre (n = 3), wing (n = 5) and full back (n = 3). The experimental protocols were done following the ethics rules for Helsinki Declaration. All experimental procedures were in accordance with the Pablo de Olavide University Ethical Committee rules. The players delivered informed written consents which had been signed. The inclusion criteria was to belong to the rugby team and the exclusion criteria was injuries that prevented the practice of rugby.

Data were collected in the training pitch facilities during the beginning of the competitive season and positions on the field were determined using a previous validated distribution[12,13].

Descriptive analysis

Anthropometric characteristics examined were height, body mass, three diameters (wrist, biepicondylar humerus and femur), six body circumferences (arm relaxed, arm tensed, thigh, calf, hip and waist perimeters) and six skin folds (triceps, subscapular, supraspinale, abdominal, thigh and calf). Measures were recollected following the recommendations from the International Society for the Advancement of Kinanthropoemtry (ISAK)[14-16]. Fat mass was calculated according to Carter´s equation[17]. Muscle mass was obtained with three different equations[18-20]. Somatotype was determined according to Carter and Health method[21,22]. Somatotype Attitudinal Distance (SAD) and Somatotype Attitudinal Mean (SAM) were also determined[21,23]. Proportionality was assessed with Z-Phantom analysis that uses a theoretical human reference and constituted a bilaterally symmetrical pattern. The values Z-Phantom were obtained from the Ross and Wilson formula[24].

Anthropometric measures were collected by a highly trained technician (ISAK level three). The body mass was collected by electronic weighing machine (Tanita UM-076). Height was determined with a stadiometer (Seca, 213 version). Skinfolds were measured with a slim guide skinfold caliper. Bone breadths and body perimeters were also collected with validated material (an anthropometric tape and a small sliding caliper).

Statistical analysis

SigmaPlot 12.5 version (Systat software) was used for Statistical Analyses. Descriptive statics (mean ± SD) were reported for the different parameters analyzed. Normality was checked to apply a parametric o nor parametric test. T-Student test or Mann-Whitney Rank Sum test analyses were used in order to explore significant differences between backs and forwards players. Z score was also determined according to the formula proposed by Ross and Wilson[24]. The level of significance was set at $p<0.05$.

Results

The mean values and SDs of anthropometric data and body composition obtained from players can be observed in Table 1. Values

Table 1. Mean ± SDs of anthropometric and body components.

Variables	Prop (n=3)	Hooker (n=2)	Second Row (n=4)	Lock (n=5)	Half-back (n=3)	Five-eight (n=3)	Centre (n=3)	Wing (n=5)	Full back (n=3)	Global Average (n=31)
Height (cm)	183.36 ± 3.33	177.30 ± 6.01	183.90 ± 2.47	176.00 ± 0.05	173.80 ± 7.97	176.7 ± 10.7	177.4 ± 0.03	168.10 ± 2.46	177.7 ±7.65	176.70 ± 7.03
Weight (kg)	108.36 ± 4.45	99.20 ± 5.79	100.50 ± 4.95	81.58 ± 6.83	75.26 ± 18.19	77.93 ± 7.55	79.76 ± 8.02	71.50 ± 3.42	85.10 ± 14.54	85.32 ± 14.36
Wrist diameter (cm)	5.66 ± 0.71	5.66 ± 0,02	5.51 ± 0.32	5.49 ± 0.22	5.17 ± 0.26	5.54 ± 0.47	5.72 ± 0.30	5.17 ± 0.31	5.29 ± 0.49	5.44± 0.38
Humerus diameter (cm)	7.17 ± 0.27	7.14 ± 0,04	7.17 ± 0.55	6.83 ± 0.52	6.71 ± 0.16	6.96 ± 0.59	7.05 ± 0.24	6.94 ± 0.30	7.31 ± 0.49	7.01 ± 0.40
Femur diameter (cm	10.32 ± 0.37	9.98 ± 0.27	10.23 ± 0.70	9.53 ± 0.18	9.90 ± 1.44	9.68 ± 0.25	9.73 ± 0.36	9.11 ± 0.34	9.51 ± 0.46	9.73 ± 0.63
Arm relaxed circumference (cm)	38.13 ± 3.11	35.85 ± 0.63	35.15 ± 2.23	33.84 ± 2.75	29.46 ± 4.66	30.56 ± 2.05	31.40 ± 3.60	32.26 ± 3.02	33.50 ± 3.90	33.29 ± 3.61
Arm tensed circumference (cm)	39.06 ± 2.95	37.25 ± 1.06	36.32 ± 2.34	36.64 ± 2.36	31.53 ± 3.86	33.23 ± 1.42	33.96 ± 3.16	34.88 ± 2.46	35.96 ± 4.17	35.44 ± 3.14
Thigh circumference (cm)	61.76 ± 1.45	59.15 ± 0.35	59.47 ± 1.50	54.98 ± 3.86	54.03 ± 5.85	54.36 ± 2.05	53.36 ± 2.37	51.74 ± 1.96	55.10 ± 3.01	55.66 ± 4.06
Calf circumference (cm)	43.20 ± 0.91	41.90 ± 0.70	42.05 ± 1.04	39.18 ± 1.69	38.16 ± 3.86	39.40 ± 2.33	38.26 ± 0.80	37.92 ± 1.47	40.23 ± 4.56	39.84 ± 2.63
Hip circumference (cm)	108.90 ± 1.99	105.50 ± 3.53	107.92 ± 3.36	93.14 ± 6.84	92.23 ± 9.05	92.36 ± 3.62	95.10 ± 7.99	91.02 ± 0.46	97.66 ± 9.20	97.49 ± 8.50
Waist circumference (cm)	101.00 ± 6.10	98.95 ± 2.89	94.25 ± 6.79	83.82 ± 6.54	77.46 ± 7.50	77.63 ± 4.70	81.23 ± 3.66	80.18 ± 4.80	82.90 ± 4.91	85.66 ± 9.51
Triceps skinfold (mm)	23.91 ± 8.00	17.12 ± 8.30	20.25 ± 4.62	10.05 ± 5.23	13.33 ± 7.02	14.50 ± 0.86	11.00 ± 2.29	10.55 ± 3.22	13.25 ± 5.13	14.39 ± 6.17
Subscapular skinfold (mm)	27.00 ± 3.50	19.00 ± 0.00	23.87 ± 4.87	12.80 ± 4.12	14.00 ± 6.55	12.91 ± 3.59	13.83 ± 2.84	12.75 ± 4.99	13.66 ± 0.76	16.30 ± 6.30
Supraspinale skinfold (mm)	28.00 ± 1.80	23.00 ± 11.31	23.81 ± 4.54	10.85 ± 5.23	12.58 ± 5.38	10.50 ± 2.17	13.50 ± 6.38	10.00 ± 2.62	14.16 ± 1.60	15.54 ± 7.57
Abdominal skinfold (mm)	33.50 ± 4.44	28.75 ± 9.54	28.00 ± 0.81	13.20 ± 3.81	16.50 ± 9.26	16.91 ± 3.71	15.00 ± 4.50	14.40 ± 4.76	19.33 ± 4.75	19.71 ± 8.26
Thigh skinfold (mm)	13.75 ± 3.03	16.37 ± 12.19	18.50 ± 3.87	12.75 ± 4.35	19.50 ± 11.05	19.00 ± 3.50	17.50 ± 6.53	12.80 ± 2.98	14.00 ± 1.00	15.66 ± 5.48
Calf skinfold (mm)	14.08 ± 1.87	11.50 ± 4.95	16.12 ± 5.89	6.95 ± 2.28	13.66 ± 7.76	13.33 ± 2.02	9.91 ± 1.90	7.65 ± 2.54	12.25 ± 3.43	11.29 ± 4.68
Σ 6 skinfolds (mm)	140.25 ± 14.35	115.75 ± 46.31	130.56 ± 19.38	66.60 ± 19.57	89.58 ± 46.13	87.16 ± 12.94	80.75 ± 17.76	68.15 ± 17.43	86.66 ± 11.47	92.92 ± 32.95
Endomorphy	6.74 ± 0.59	5.58 ± 1.69	6.06 ± 0.86	3.34 ± 1.17	4.00 ± 1.68	3.74 ± 0.39	3.77 ± 0.88	3.45 ± 1.05	4.02 ± 0.45	4.50 ± 1.50
Mesomorphy	6.42 ± 0.40	6.65 ± 0.36	5.67 ± 0.98	5.93 ± 1.11	5.05 ± 1.11	5.24 ± 0.76	5.20 ± 1.05	6.24 ± 0.59	6.01 ± 0.97	5.80 ± 0.91
Ectomorphy	0.18 ± 0.09	0.10 ± 0.13	0.69 ± 0.32	1.16 ± 1.20	1.56 ± 1.04	1.71 ± 0.92	1.59 ± 0.64	1.12 ± 0.52	1.07 ± 0.28	0.95 ± 0.84
Body fat %	17.32 ± 1.51	14.75 ± 4.86	16.30 ± 2.04	9.58 ± 2.06	12.00 ± 4.84	11.74 ± 1.36	11.07 ± 1.86	10.16 ± 1.93	11.41 ± 1.56	12.35 ± 3.46
Muscle mass Heymsfield y cols (%)	38.65 ± 2.73	42.15 ± 0.10	42.80 ± 2.48	52.16 ± 5.00	56.72 ± 12.49	53.94 ± 2.41	53.58 ± 4.83	56.53 ± 3.25	50.47 ± 6.40	50.29 ± 7.74
Muscle mass Doupe (%)	47.25 ± 2.27	47.38 ± 4.87	45.65 ± 3.25	54.34 ± 2.48	47.07 ± 4.31	48.08 ± 1.70	48.67 ± 0.97	53.06 ± 4.68	50.48 ± 3.03	49.55 ± 4.21
Muscle mass Lee-I (%)	31.13 ± 2.19	32.44 ± 1.02	32.12 ± 2.51	37.82 ± 2.46	38.86 ± 6.86	38.16 ± 1.46	37.26 ± 3.48	39.27 ± 1.52	36.51 ± 2.31	36.2 ± 3.93

Data frequencies for 31 rugby players.

in function of different position (prop, hooker, second row, lock, half-back, five-eight, centres, wing and full back) can be visualized. Statistical differences among these different positions were not analyzed due to there is not enough statistical power to determine differences due to the sample size (2-5 players for each specific position).

Table 2 groups examined players in forward positions (prop, hooker, second row, lock) and backs positions (half-back, five-eight, centre, wing and full back) in order to look for differences between these two groups.

Somatotype classification were props (endomorphy-mesomorphy), hookers (endo-mesomorphy), second-rows (endomorphy-mesomorphy), locks (endo-mesomorphy), half-backs (endo-mesomorphy), five-eights (endo-mesomorphy), centres (endo-mesomorphy), wings (endo-mesomorphy), full backs (endo-mesomorphy), global average (endo-mesomorphy), forwards average (endo-mesomorphy) and backs average (endo-mesomorphy). These results can be observed in Figure 1.

In Table 3 can be seen the individual SAD for each player refers to the mean somatotype value. While, SAD values in function of the position in the field has been analyzed in Table 4. The value obtained in SAM was 1.7 units. In Figure 1 can be observed the Phanton proportionality analyses for body mass, arm-relax circumference, waist circumference,

Table 2. Mean ± SDs of anthropometric data forwards and backs average.

Variables	Forwards Average (n=14)	Backs Average (n=17)	*P* value
Height (cm	180.00 ± 50.00	174.00 ± 70.40	*p* = 0.0140
Weight (kg)	95.24 ± 12.17	77.15 ± 10.48	*p* = <0.001
Wrist diameter (cm)	5.55 ± 0.35	6.99 ± 0.37	*p* = 0.144
Humerus diameter (cm)	7.04 ± 0.44	9.53 ± 0.65	*p* = 0.697
Femur diameter (cm)	9.96 ± 0.52	9.53 ± 0.65	*p* = 0.056
Arm relaxed circumference (cm)	35.42 ± 2.77	31.53 ± 3.30	*p* = 0.002
Arm tensed circumference (cm)	37.15 ± 2.36	34.02 ± 3.04	*p* = 0.004
Thigh circumference (cm)	58.31 ± 3.60	53.48 ± 3.04	*p* = <0.001
Calf circumference (cm)	41.25 ± 2.02	38.69 ± 2.56	*p* = 0.005
Hip circumference (cm)	102.50 ± 8.49	93.36 ± 6.05	*p* = 0.002
Waist circumference (cm)	92.64 ± 9.12	79.91 ± 4.93	*p* = <0.001
Triceps skinfold (mm)	16.94 ± 7.50	12.29 ± 3.91	*p* = 0.034
Subscapular skinfold (mm)	19.89 ± 6.97	13.35 ± 3.82	*p* = 0.002
Supraspinale skinfold (mm)	19.96 ± 8.73	11.89 ± 3.79	*p* = 0.002
Abdominal skinfold (mm)	24.00 ± 9.42	16.19 ± 5.16	*p* = 0.007
Thigh skinfold (mm)	15.12 ± 5.34	16.11 ± 5.73	*p* = 0.625
Calf skinfold (mm)	11.75 ± 5.29	10.92 ± 4.24	*p* = 0.634
Σ 6 skinfolds (mm)	107.67 ± 38.30	80.77 ± 22.30	*p* = 0.021
Endomorphy	5.31 ± 1.73	3.76 ± 0.90	*p* = 0,013
Mesomorphy	6.06 ± 0.88	5.63 ± 0.92	*p* = 0,191
Ectomorphy	0.62± 0.86	1.33 ± 0.68	*p* = 0.002
Body fat %	13.90 ± 4.02	11.07 ± 2.34	*p* = 0.021
Muscle mass Heymsfield y cols (%)	45.16 ± 6.48	54.54 ± 6.03	*p* = <0.001
Muscle mass Doupe (%)	49.34 ± 4.73	49.89 ± 3.87	*p* =0.362
Muscle mass Lee-I (%)	33.99 ± 3.62	38.16 ± 3.17	*p* = 0.002

Table 3. Individual Somatotype Attitudinal Distance (SAD) refers to group somatotype.

Position	SAD
Prop	3.11
Prop	2.23
Hooker	2.60
Hooker	0.91
Second row	2.53
Second row	1.80
Second row	1.33
Second row	1.90
Lock	0.78
Lock	4.00
Lock	2.40
Lock	1.08
Lock	1.03
Half back	1.09
Half back	1.64
Half back	3.44
Five-eight	2.37
Five-eight	0.72
Five-eight	1.29
Centre	0.91
Centre	2.22
Centre	1.85
Wing	0.84
Wing	1.46
Wing	2.69
Wing	1.15
Wing	1.66
Full back	1.33
Full back	0.59
Full back	1.13

Data frequencies for 31 rugby players.

Table 4. Somatotype Attitudinal Distance (SAD) for rugby positions refers to group somatotype.

Position	Mean	SD	Maximum	Minimum
Prop (n=3)	2.43	0.60	3.11	1.95
Hooker (n=2)	1.75	1.19	2.60	0.91
Second row (n=4)	1.89	0.49	2.53	1.33
Lock (n=5)	1.85	1.35	4.00	0.78
Half back (n=3)	2.05	1.22	3.44	1.09
Five-eight (n=3)	1.46	0.83	2.37	0.72
Centre (n=3)	1.66	0.67	2.22	0.91
Wing (n=5)	1.56	0.704	2.69	0.84
Full back (n=3)	1.01	0.38	1.33	0.59
Forwards (n=14)	1.98	0.95	4.00	1.78
Backs (n=17)	1.55	0.76	3.44	0.59
Global average (n=31)	1.73	0.86	4.00	0.59

Data frequencies for 31 rugby players

Figure 1. Somatotype components and Proportionality Phantom analysis.

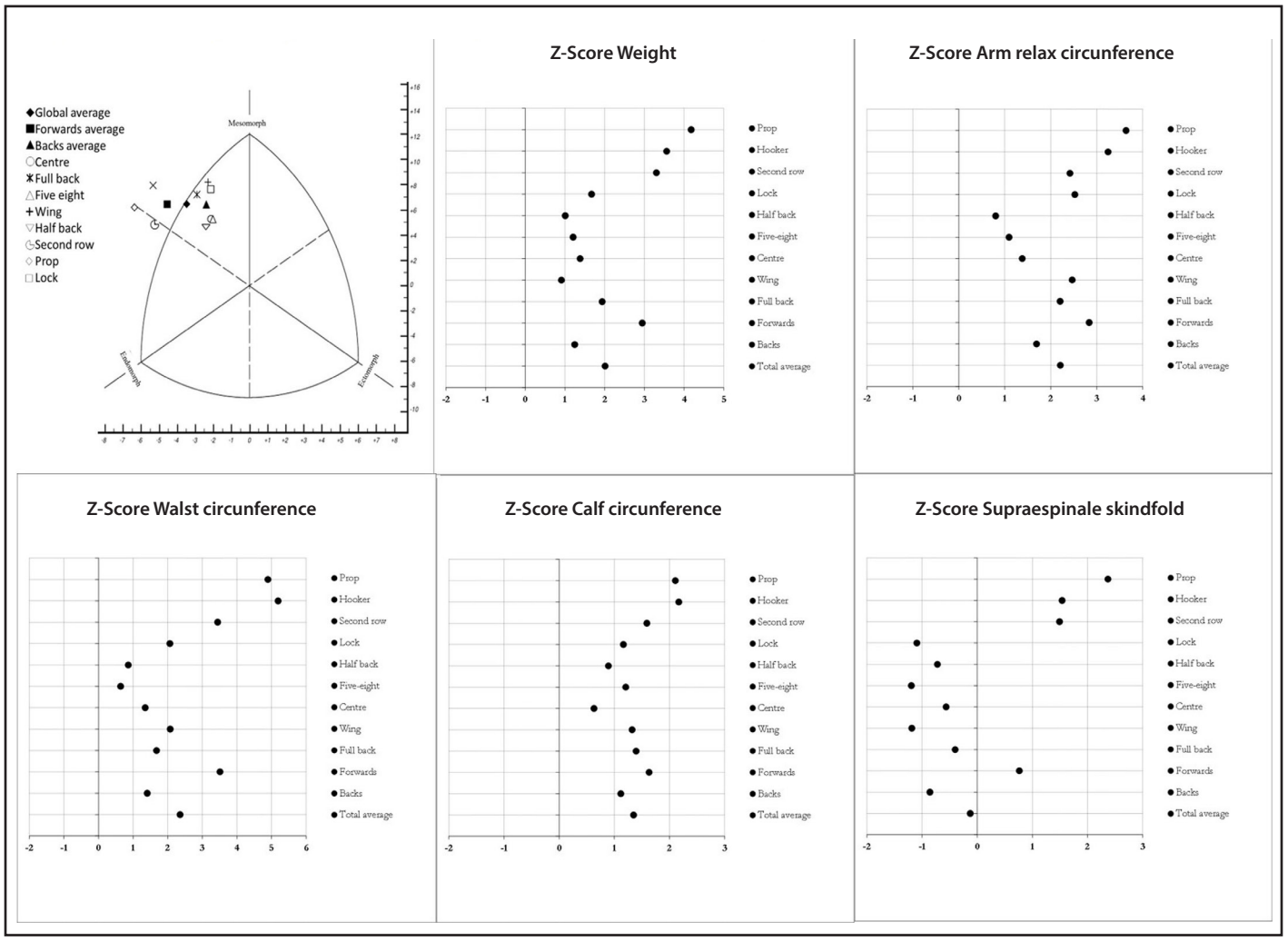

Table 5. Proportionality Phantom analysis.

	Diameters			Circunferences		Skinfolds			
	Humerus	**Wrist**	**Femur**	**Hip**	**Triceps**	**Subscapular**	**Abdominal**	**Thigh**	**Calf**
Prop	0.50	0.15	0.13	0.93	1.50	1.34	0.73	-1.71	-0.63
Hooker	1.09	0.83	0.16	1.21	0.27	0.21	0.31	-1.33	-1.04
Second row	0.43	-0.39	-0.10	0.93	0.75	0.97	0.07	-1.19	-0.23
Lock	0.37	0.36	-0.62	-0.80	-1.27	-0,.96	-1.62	-1.76	-1.98
Half back	0.29	-0.51	0.32	-0.81	-0.57	-0.72	-1.22	-0.98	-0.61
Five-eight	0.62	0.45	-0.38	-1.01	-0.32	-0.96	-1.18	-1.04	-0.67
Centre	0.82	0.99	-0.37	-0.62	-1.09	-0.78	-1.42	-1.23	-1.62
Wing	1.56	0.09	-0.61	-0.45	-1.06	-0.85	-1.39	-1.69	-1.77
Full back	1.49	-0.54	-0.84	-0.22	-0.63	-0.81	-0.88	-1.63	-0.93
Forward	0.52	0.17	-0.20	0.35	0.12	0.25	-0.36	-1.52	-1.06
Backs	1.03	0.09	-0.41	-0.60	-0.77	-0.83	-1.24	-1.36	-1.20
Global average	0.80	0.13	-0.31	-0.17	-0.37	-0.34	-0.84	-1.43	-1.13

Table 6. Somatotypes previously described for rugby players.

Reference	Sample analyzed (n)	Endomorphy	Mesomorphy	Ectomorphy
Cheng, *et al*. 2014[31]	Australian junior elite rugby league players (116)	3.6 ± 1.0 (f) 2.6 ± 0.7 (b)	7.5 ± 1.3 (f) 6.5 ± 0.8 (b)	1.0 ± 0.9 (f) 1.7 ± 0.7 (b)
Pienaar & Coetzee 2013[35]	University level rugby players (U19 North-West University, South Africa)[35]	2.63 ± 0.91 2.54 ± 0.97 2.97 ± 1.52 2.88 ± 1.38	6.20 ± 1.18 6.33 ± 1.15 5.82 ± 1.49 5.93 ± 1.56	1.73 ± 1.07 1.77 ± 1.11 1.71 ± 1.15 1.75 ± 1.15
Babic, *et al.* 2001[10]	Rugby players from clubs member of the Croatian-Slovenian rugby league	6.0 ± 1.6 (g) 6.7 ± 1.5 (f) 5.3 ± 1.4 (b)	5.6 ± 1.3 (g) 5.9 ± 1.3 (f) 5.3 ± 1.1 (b)	1.4 ± 0.8 (g) 1.4 ± 0.9 (f) 1.5 ± 0.7 (b)
Babic, *et al*., 2001[10]	Rugby players from New Zealand rugby league	3.7 (f) 2.5 (b)	6.5 (f) 6.2 (b)	1.2 (f) 1.4 (b)
Babic, *et al.,* 2001[10]	Rugby players from Italy league	3.5 (f) 2.6 (b)	6.1 (f) 4.9 (b)	1.0 (f) 2.0 (b)
Babic, *et al*., 2001[10]	Rugby players from South Africa league	3.8 (f)	6.1 (f)	1.6 (f)
Babic, *et al.,* 2001[10]	Rugby players from France league	3.0 (f) 2.5 (b)	6.0 (f) 5.0 (b)	1.0 (f) 2.5 (b)
Hohenauer, *et al.* 2017[37]	German national rugby union 7s team (17)	2.5 ± 0.74 (g) 2.46 ± 0.77 (f) 2.54 ± 0.71 (b)	6.53 ± 0.84 (g) 6.6 ± 1.08 (f) 6.46 ± 0.61 (b)	1.31 ± 0.64 (g) 1.43 ± 0.85 (f) 1.19 ± 0.44 (b)
Holway & Garavaglia 2009[38]	Rugby players from the seven Group I teams competing in the Buenos Aires Rugby Union (133)	3.3 ± 1.3 (g)	6.8 ± 1.2 (g)	1.1 ± 0.8 (g)
Gabbet 2009[30]	Rugby players from the first-grade rugby in the Goald Coast senior rugby league (Queensland, Australia) (12)	3.1 (best tacklers) 5.4 (worst tacklers)	4.0 (best tacklers) 3.6 (worst tacklers)	0.9 (best tacklers) 1.0 (worst tacklers)
Quarrie, *et al.* 1996[36]	Male senior A rugby club players (New Zealand) (94)	4.5 (props, f) 3.6 (hookers,f) 3.7 (locks,f) 3.7 (loose forwards, f) 2.3 (inside backs, b) 3.1 (midfiled backs,b) 2.4 (outside backs, b)	7.5 (props, f) 7.1 (hookers,f) 5.9 (locks,f) 6.2 (loose forwards, f) 6.2 (inside backs, b) 6.7 (midfiled backs,b) 6.0 (outside backs, b)	0.5 (props, f) 0.9 (hookers,f) 1.6 (locks,f) 1.3 (loose forwards, f) 1.5 (inside backs, b) 1.3 (midfiled backs,b) 1.6 (outside backs, b)

g: global; f: forwards; b: backs.

calf circumference and supraespinale skinfold. The rest of z-values for the other parameters examined are showed in Table 5.

Discussion

The mean body mass and height were 85.32 ± 14.36 kg and 176.70 ± 7.03 cm, the mean sum of 6 skinfolds (triceps, subscapular, supraspinale, abdominal, thigh and calf) was 92.92 ± 32.95 mm. The mean fat percentage was 12.35 ± 3.46% while the mean somatotype values were 4.50 ± 1.50 - 5.80 ± 0.91 – 0.95 ± 0.84. Significant differences between forwards and backs players were obtained in body mass, height, skinfolds, body composition and somatotype components.

Additionally, in the rating scale and somatotype analyses[21], endomorphy values observed in prop, hooker and second row positions are higher than 5 ½ showing a probable high relative adiposity, abundant subcutaneous fat and abdominal fat accumulation. It could be helpful in some specific phases of rugby games. The rest of players exhibited endomorphy values between 3 and 5 indicating a moderate relative adiposity. Moreover, mesomorphy data revealed that subjects analyzed present a high relative skeletal muscle development, large bone diameters, large volume muscles and large joints. Ectomorphy values showed a high body volume per unit of height and their limbs could be relative voluminous. In comparison with somatotypes obtained in rugby players in other studies (Table 6), endomorph component tends

to be higher in players analyzed and it could be related with the level of professionalism because amateur players could pay less attention to their adiposity level. While, mesomorph and ectomorph elements seem to be similar.

SAD examination is based on three dimensions and provided precise information about the distance of individuals in relation to the group somatotype. When a subject is closer to "0" value, less is the difference in reference to the group. It has been proposed that a "2" value in SAD is the limit to consider a possible difference. Here in Table 3, ten players presented a value bigger than 2 units and consequently a difference in some of the three somatotype components. Additionally, 1.7 units (higher than 1) was the value obtained in SAM analyses indicating a difference in homogeneity of the group somatotype[25].

Phantom method is used to examine proportionality, a z-value of 0.0 means that the subject has the same proportions to the Phantom. A z-value greater than 0.0 indicates that the subject has higher proportions than the Phantom and a lower z-value shows smaller proportions than the Phantom reference[24,26]. Particularly, our players tend to have greater z-values indicating bigger proportions than the Phantom and backs position tends to have lower z-values for supraespinale skinfold presenting a lower adiposity than the Phantom reference.

Previously, another study[27] examined changes in body composition from the preseason to the end of the season. Players were away from the recommended body composition standard at the beginning of the season. While in the present study, similar fat percent values have been obtained, it is possible that players were also away from the recommended values for body composition in rugby. Another research[10] examined the effects of a microcycle combined with rugby conditioning program on anthropometric measures. All players showed lower skinfold thickness than skinfold values found in the current research. This is related to the previous idea mentioned that players analyzed might be away from the recommended standard of body composition.

A previous study[28] explored the anthropometric profile of elite rugby seven players. They presented lower values than players from the present study for skinfolds; several factors could explain this situation. The measures of sevens rugby player were taken during the international competition season when the players surely presented a high level of physical condition. The data of our players were taken at the beginning of the season when they did not play competitive matches, sevens rugby players were elite level athletes while our players were nonprofessional, suggesting that the level of professionalism could affect to body composition. Supplementary to this last idea, one study[29] analyzed amateur rugby players. Anthropometric characteristics of nonprofessional players were poorly developed compared with professional players. Even, another investigation[30] found that sub-elite rugby players exhibited a higher sum of seven skinfolds than elite players. Consequently, the level of professionalism could affect to anthropometrical characteristics of players.

Another study[10] found that forwards were heavier, taller and presented higher fat percentage than backs, these discoveries were also found in our investigation where forwards showed a higher body mass, height and body fat percentage than backs. Other studies[12,13] found that props were taller, heavier and had higher skinfold thickness than the rest of players. Additionally, props were heavier and presented the highest values in the sum of six skinfolds and in body fat and they were almost the tallest players. Moreover, another research[29] discovered differences in body mass between forwards and backs. Taking all these data in consideration, we think that it could exist differences among playing position in rugby. Furthermore, differences were obtained in some anthropometric characteristics between forwards and backs positions such as in body mass, sum of 6 skinfolds, body fat percent, muscular mass, endomorphy and ectomorphy components. As a paper[31] introduced some years ago, the physical rugby performance and anthropometric characteristics observed in players could be tightly related to the demands imposed by their position.

Previously, it has been proposed that anthropometric and body composition studies are really useful in sport performance management[32-34]. The current study is one of the first studies that examines anthropometrical profile in amateur Spanish rugby players and it shows the potential advantages of anthropometry, somatotype and body composition analyses on rugby. It seems that differences could exist between forwards and backs players in body mass, height, skinfolds, body composition and somatotype components, consequently training plans and diets prescription should take in consideration rugby player´s position in the field. Furthermore, the present paper proposes that the levels of professionalism could affect to body composition in rugby players. Therefore, the level of professionalism should be considered in anthropometric analysis. Thus, further meticulous research is needed to support these ideas.

The present study has limitations, for example only Spanish nonprofessional male rugby players have been studied. Accordingly, the results cannot be extrapolated to the rest of rugby male players, female rugby players or other team sports.

Finally, anthropometrical measures would be an adequate instrument to evaluate body composition in rugby. It has been proposed that anthropometric profile in rugby could be related to the specific position on the field, although further studies would be necessary to confirm this theory. The level of professionalism could affect to the anthropometrics characteristics in rugby players.

Conflict of interest

The authors do not declare a conflict of interest.

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