Anthropometric profile of Argentine elite Judokas

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ABSTRACT

Introduction: judo is a combat sport whose competitive classification depends on body weight, intended to promote even and equitable competitions in terms of physical abilities. Advances in the sciences of training and sports nutrition have led to an improvement in the body composition of athletes, resulting in an increase in muscle mass and a decrease in adipose mass.

This study aimed to estimate the body composition of judo fighters participating in the 2021 Argentine National Championship.

Materials and methods: we conducted a descriptive cross-sectional study of participants of the 2021 national judo championship. We evaluated 183 judokas (51 women and 132 men) applying the ISAK measurement protocol. We used the Kerry Ross five-component fractional anatomic method to determine body composition.

Results: the average for female judo players was 30.5% for adipose mass and 44.5% for muscle mass; we found no statistically significant differences in the different age groups. The average value for males was 22.4% for adipose mass and 49.1% for muscle mass; in this case, we found significant differences between the different age groups for adipose mass and muscle and bone mass.

Discussion: there is a need for more studies with stratified groups according to body weight division to establish specific reference standards for the work in exercise science and nutrition.

Conclusion: the optimization of the body composition of female and male judo players has a positive effect on the improvement of specific physical capacities. The data presented constitute a relevant reference for the evaluation and follow-up of judokas. The stratification by age groups and body weight division will allow a better delimitation of the values of each age category.

Linking body composition with physical tests and results is considered relevant to obtain a better profile of the Argentinian judo player.

Key words: body composition, anthropometry, judo, combat sports.

INTRODUCTION

Judo is a combat sport where the main pre-competitive classification is by body weight division. In recent years, scientific studies[1-4] showed that it is not only the athlete's body weight that is important but also how this weight is composed. That could impact the development of physical capacities of strength and muscular power required for performance sports in general and judo in particular.

According to Capone[5], the study of these morphofunctional characteristics of athletes may be associated with higher levels of sporting excellence and physical performance. Therefore, there is a close relationship between body shape and physical performance, making it meaningful to evaluate, determine and stratify athletes to secure the improvement of sports performance[6,7].

Anthropometry is the science of describing and analyzing the shape, size, proportion, and human body composition. Through measurements, it is possible to estimate body composition and determine muscle, fat, and bone mass values for work in exercise, nutrition, and health sciences[7,8].

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The judo player's physical preparation and nutritional approach aim at developing greater mechanical efficiency and applied forces. That implies increasing muscle mass and decreasing adipose mass to ideal values without compromising health and sports performance[9].

The study's overall objective was to estimate the body composition of the male and female judokas participating in the Argentine National Championship of the year 2021. The lack of specific and comparative data for work in exercise and health sciences is one of the limitations of the current published works[2,10-12].

MATERIALS AND METHODS

Anthropometric measurements were taken of the judokas participating in the Argentine National Judo Championship held in Villa Carlos Paz, province of Córdoba, Argentina, between November 18 and 21, 2021. Out of a total of 425 participants, 183 judokas voluntarily decided to take part in the evaluation. Of these, 51 were women, while 132 were men.

We used the ISAK 13 (International Society for the Advancement of Kinanthropometry) protocol for the evaluation of body composition, consisting of the following determinations:

Basic measurements: body weight, standing height, sitting height, and wingspan. Body perimeters: cephalic, relaxed arm, flexed arm, maximum forearm, midsternal thorax, minimum waist, maximum hip, maximum thigh, medial thigh, and maximum calf. Skin folds: tricipital, subscapular, suprascapular, abdominal, medial thigh, and medial calf. Bone diameters: bi-acromial, transverse thorax, anteroposterior thorax, biiliocristal, humeral, and femoral.

Size, bone diameters, and perimeters were recorded with a 1-mm precision, folds with a 0.5 mm precision, and weight with a 0.1 kg precision. Body weight was measured with a Cam® brand mechanical scale. Height, sitting height, and wingspan were measured using a Seca® portable measuring rod; diameters were evaluated with anthropometric calipers of short branches (Campbel 10®) and long branches (Campbel 20®), Rosscraft srl brand. Perimeters were measured using Lufkin® brand flexible and inextensible anthropometric tape (model WP606), 2 m long and 0.5 cm wide. Gaucho Pro® brand plicometers, pre-calibrated, were used to measure skinfolds.

We used anthropometric boxes measuring 30*40*50 cm, as indicated by the ISAK13, and dermatographic pencils for marking the anatomical reference points.

Processing and data analysis was performed with the Excel program, Microsoft Office 365® and using the specific equations of the 5-component model (adipose, muscle, residual, bone and skin masses), proposed by ISAK. The IBM SPSS Macintosh software, version 25.0® (IBM Corp., Armonk, NY, USA), was used for data analysis.

The study protocol was approved by the institutional ethics committee of the Argentine Judo Confederation and carried out following the guidelines established by the modified Helsinki Declaration. The athletes participated voluntarily, informed of the implications and usefulness of the evaluations; they received no monetary compensation for their participation.

The evaluators who participated in the measurement had ISAK level 2 or 3 accreditation, with a minimum of 2 years of practical experience.

Financing: the study was partly financed by the Argentine Judo Confederation and the Cordoba Judo Federation.

RESULTS

The age categories included in the present study were: cadets (between 15 and 17 years of age), novice kiu (over 15 years of age with graduation equal to orange belt or less), junior (athletes between 18 and 19 years of age) and senior (over 15 years of age with graduation higher than blue belt). The average age for females was 19.3 ± 4.3 years (mean± SD), while the average age of the males was 21.2 ± 6.4 (mean ± SD).

All variables are expressed as a mean and standard deviation.

Table 3 presents the raw data of male judokas.

Table 4 presents the body composition values and anthropometric derivatives of male judokas.

Table 5 shows the comparative values by age category, divided by sex.

DISCUSSION

The values presented were collected in conditions before or immediately after the qualifying weighing of the competition. These conditions may differ from other studies[14-17], yielding very different values. We suggest carrying out studies in general moments of the athletes' preparation to establish how much difference exists between pre-competitive and regular periods of sports preparation.

When analyzing the female judo players, no differences were found between the age groups for any of the variables compared. However, this contrasts with the published scientific evidence[9,18], which describes significant differences between the different age groups.

There were no statistically significant differences in the body fat mass between the cadet, junior, and senior age groups for males, while significant differences were found when compared to the kiu novice group. These results would be associated with the fact that the kiu novice group tends to have fewer years of sports practice, with a lower sports performance and, therefore, less dedication to training and its development.

Table 1. Anthropometric Variables in female Judo

	Variables	Women total (n = 51)	Cadets fem (n = 19)	Kiu nov fem (n = 8)	Junior/Senior fem (n = 24)
BASICSS	Age (years))	19 ± 4.3	16.2 ± 0.6	16.6 ± 1.3	22.2 ± 4.5
	Weight (kg)	60.7 ± 14.1	56.9 ± 13.8	60.3 ± 13.5	63.8 ± 14.5
	Standing hight (cm)	161.2 ± 6.6	161.4 ± 8.6	163.5 ± 5	160.4 ± 5
	Sitting height (cm)	83.8 ± 3.1	84.4 ± 3.9	82.9 ± 2.4	83.6 ± 2.6
	Arm span (cm)	163.1 ± 7.3	162.2 ± 7.9	166.9 ± 6.7	162.7 ± 6.8
DIAMETERS (cm	Biacromial	36.4 ± 3.3	36.0 ± 3.8	35.7 ± 5.2	37.0 ± 2
	Thorax transverse	25.8 ± 2.9	24.7 ± 3.3	25.9 ± 2.8	26.5 ± 2.3
	Thorax anteroposterior	17.9 ± 2.9	17.3 ± 2.8	19.2 ± 3.7	17.9 ± 2.7
	Biileocrestoid	27.3 ± 2.9	26.4 ± 2.5	27.5 ± 2.2	28.0 ± 3.3
	Humeral	6.4 ± 0.9	6.1 ± 0.5	6.2 ± 0.5	6.6 ± 1.1
	Femoral	9.0 ± 0.8	8.8 ± 0.7	9.3 ± 0.7	9.1 ± 0.9
PERIMETERS (cm)	Head	55.1 ± 2.3	54.6 ± 2	56.3 ± 3.9	55.1 ± 1.8
	Relaxed arm	28.5 ± 4.1	27. 0 ± 3.7	27.1 ± 4.2	30.2 ±3.8
	Flexed arm	28.9 ± 3.3	27.6 ± 2.3	27.2 ±3.2	30.4 ± 3.3
	Forearm	24.1 ± 2	23.7 ± 2.1	23.4 ± 2.1	24.6 ± 1.8
	Mesosternal thoraxl	87.5 ± 8.8	84.6 ± 9.5	86.4 ± 7	90.1 ± 8.4
	Waist	70.9 ± 9.9	68.3 ± 8.3	68.9 ± 9.6	73.6 ± 10.9
	Maximum hip	93.0 ± 17.3	90.0 ± 17.4	92.5 ± 13.9	95.6 ±18.5
	Maximum thigh	57.5 ± 7.4	55.6 ± 5.6	56.4 ± 7.1	59.5 ± 8.5
	Maximum calf	35.0 ± 5	33.4 ± 3.3	37.1 ± 9	35.6 ± 4
FOLDS (mm)	Triceps	13.3 ± 6	11.8 ± 5	12.0 ± 3.5	14.9 ± 7.1
	Subscapular	12.4 ± 6.9	10.6 ± 6	10.5 ± 2.7	14.3 ± 8
	Supraspinal	10.8 ± 6.6	10.2 ± 7	7.9 ± 1.8	12.2 ± 7.1
	Abdominal	15.1 ± 7.6	13.4 ± 6.5	13.3 ± 4.5	17.0 ± 9
	Medial thigh	20.9 ± 8	18.3 ± 6.8	23.5 ± 7.6	22.0 ± 8.7
	Calf	15.0 ± 6.9	13.7 ± 6.5	15.4 ± 5.7	15.6 ± 7.6

All variables are expressed as a mean and standard deviation

When comparing the sum of male skinfolds, we only observed statistically significant differences between the groups of cadets and novice kiu, coinciding with Datta[19] when describing the differences for the same groups.

In the muscle mass variable, we observed statistically significant differences only when comparing the cadet group with the senior male group, probably associated with the younger age of the first group. The stages of growth and development in the human body and the longer time dedicated to specific competitive training may justify this difference in body composition. These differences coincide with those described in the literature[7,20-22], when it is noted that senior category athletes have the highest muscle mass values of all age groups, regardless of the body weight category.

For the bone mass variable in males, we observed statistically significant differences only between the cadet and senior categories. Similar differences are found in

Table 2. Body composition and anthropometric derivatives in female judo

	Variable	Women total (n = 51)	Cadets fem. (n = 19)	Kiu novicie fem (n = 8)	Junior/senior fem. (n = 24)
PROPORTIONALITY	Fat Z	-0.71 ± 1.05	-1 ± 0.86	-0.88 ± 0.54	-0.42 ± 1.42
	Muscle Z	1.3 ± 1.22	0.82 ± 0.95	0.9 ± 1.42	1.82 ± 1.18
	Bone Z	0.15 ± 1.16	-0.31 ± 0.83	-0.16 ± 1.29	0.61 ± 1.21
BODY MASSES (kg)	Fat	18.5 ± 6.7	17.3 ± 7.4	18.3 ± 3.8	19.5 ± 6.9
	Muscle	27.0 ± 6.8	24.9 ± 6.7	26.2 ± 7.6	28.9 ± 6.5
	Bone	7.0 ± 1.7	6.5 ± 1.8	7.1 ± 1.9	7.4 ± 1.6
	Residual	6.2 ± 1.8	5.6 ± 1.6	6.2 ± 1.7	6.6 ± 2
	Skin	3.4 ± 0.4	3.3 ± 0.4	3.4 ± 0.4	3.4 ± .04
% RELATIVES	Fat mass	30.5 ± 11.0%	30.4 ± 9.5%	30.3 ± 8.8%	30.6 ± 12.3%
	Muscle Mass	44.5 ± 11.3 %	43.7 ± 9.1%	43.4 ± 9.2%	45.3 ± 11.2%
DERIVED ANTHROPOMETRICS	Σ 6 skinfolds (mm)	87.2 ± 36.2	78 ± 32.7	82.6 ± 19.2	96.1 ± 41.7
	Body mass indexndice de masa corporal (kg/m*m)	23.3 ± 4.2	22.4 ± 3.8	22.5 ± 5.4	24.8 ± 6.1
	Muscle/bone index	3.92 ± 0.86	3.9 ± 0.58	4 ± 1.98	3.9 ± 0.38
	Fat/muscle index	0.68 ± 0.13	0.69 ± 0.13	0.72 ± 0.11	0.67 ± 0.38

All variables are expressed as a mean and standard deviation.

Σ Six skinfolds: algebraic sum of triceps, subscapular, supraspinal, abdominal, medial thigh, and calf skinfolds. Body mass index: current weight/height* calf.

the literature[7,23] when comparing age groups with the evolution of bone mass.

When contrasting the values described by Capone[5], notable differences arise with those of the present study due to the great variety of methods and equations that now exist for estimating body composition[7]. Some published works deal with anatomically analyzable components, others use chemical estimation models, while others study body composition using atomic analysis models. We suggest that special attention be paid to this aspect since, when comparing the results, similar analysis models should be used[3,7,12,21,24,25].

CONCLUSION

The main classification criterion in judo is by body weight division; optimizing the composition of this weight improves specific physical abilities, provided that it goes hand in hand with adequate training, nutrition, and rest.

The data presented here is a specific and updated national reference suitable for evaluating, monitoring, detecting, and following up on national-level Judo athletes. The stratification by age groups and body weight division, together with larger sample sizes, will enable a better delimitation of the values of each age category.

We consider it relevant to link body composition values with physical tests and sports results in future works to establish a better profile of the Argentine judo player.

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Conflict of interest: the authors declare no conflict of interest.

Table 3. Anthropometric Variables in male Judo

	Variables	Varones total (n=132)	Cadetes masc. (n=45)	Kiu nov. masc. (n=21)	Junior/seniormasc. (n=66)
BASICS	Age (years)	21.2 ± 6.4	16.4 ± 1.1	23.2 ± 8.1	23.9 ± 6.1
	Weight (kg)	70.5 ± 14.2	63.9 ± 11.8	74.3 ± 17.1	73.8 ± 13.1
	Hight (cm)	171.2 ± 6.9	168.7 ± 7.3	172.3 ± 7.2	173.6 ± 6.2
	Sitting hight (cm)	87.6 ± 3.7	86.3 ± 4	87.2 ± 3.4	88.6 ± 3.3
	Arm span (cm)	174.4 ± 7.4	173.1 ± 8.2	175.8 ± 9.8	174.8 ± 5.8
DIAMETERS (cm)	Biacromial	40.7 ± 3.3	39.7 ± 2.2	40.7 ± 2.3	41.3 ± 4
	Thorax transverse	28.7 ± 2.8	27.6 ± 2.5	29.2 ± 2.7	29.4 ± 2.8
	Thorax anteroposterior	20.3 ± 3.2	19.2 ± 2	20.5 ± 2.4	21.0 ± 3.8
	Biileocrestoid	28 ± 2.6	26.9 ± 2.3	29.1 ± 3.1	28.4 ± 2.5
	Humeral	6.9 ± 0.5	6.7 ± 0.5	6.9 ± 0.6	7.0 ± 0.5
	Femoral	9.6 ± 0.7	9.5 ± 0.6	9.9 ± 0.8	9.7 ± 0.8
PERIMETERS (cm)	Head	56.1 ± 2	55.6 ± 1.9	56.7 ± 1.9	56.3 ± 2.1
	Relaxed arm	30.2 ± 4.1	28.4 ± 3.6	31.1 ± 4.9	31.1 ± 3.8
	Flexed arm	21.8 ± 3.8	30.9 ± 2.9	33.1 ± 4.1	34.1 ± 3.8
	Forearm	27.3 ± 5.6	25.6 ± 2.4	27.2 ± 2.8	28.5 ± 7.2
	Mesosternal thorax	94.5 ± 10.8	90.6 ± 7.3	97.0 ± 10.4	96.5 ± 12.2
	Waist	77.0 ± 11.2	73.4 ± 9.1	80.7 ± 11.9	78.3 ± 11.7
	Maximum hip	94.0 ± 10.6	91.5 ± 8.4	97.2 ± 10.9	94.8 ± 11.5
	Maximum thigh	56.1 ± 7.4	53.8 ± 6.7	57.6 ± 8.2	57.4 ± 7.4
	Maximum calf	35.2 ± 3.9	34.6 ± 3	36.3 ± 3.8	35.3 ± 4.3
FOLDS (mm)	Triceps	7.4 ± 3.6	7.1 ± 3.5	8.8 ± 4.4	7.3 ± 3.5
	Subscapular	9.7 ± 5	7.9 ± 3.2	11.9 ± 6.1	10.3 ± 5.3
	Supraspinal	8.4 ± 6.4	7.2 ± 5	12.5 ± 10	8 ± 5.2
	Abdominal	12.4 ± 8.6	9.8 ± 6.7	17.5 ± 12	12.6 ± 7.8
	Medial thigh	10.1 ± 4.9	9.7 ± 5.3	11.7 ± 5.1	9.8 ± 4.5
	Calf	7.8 ± 4.1	7.8 ± 3.8	9.7 ± 6	7.3 ± 3.5

All variables are expressed as a mean and standard deviation.

Table 4. Body composition and anthropometric derivatives in male judo

	Variable	Varones total (n = 132)	Cadetes masc. (n = 45)	Kiu nov. masc (n = 21)	Junior/senior masc (n = 66)
PROPORTIONALITY	Fat Z	. -1.75 ± 0.8	. -1.91 ± 0.7	. -1.3 ± 1.2	.-1.78 ± 0.73
	Muscle Z	1.73 ± 0.4	1.27 ± 1.1	1.9 ± 1.8	2 ± 1.4
	Bone Z	0.44 ± 1	0.2 ± 0.7	0.63 ± 1.2	0.52 ± 1.1
BODY MASSES (kg)	Fat	15.8 ± 5.7	14.2 ± 4.9	18.8 ± 7.4	16 ± 5.4
	Muscle	34.6 ± 9.1	30.7 ± 7.2	36.1 ± 10.4	36.8 ± 9.1
	Bone	8.66 ± 1.7	8.0 ± 1.4	9.1 ± 1.9	8.9 ± 1.8
	Residual	8.3 ± 2.4	7.4 ± 1.9	8.7 ± 2.4	8.7 ± 2.5
	Skinl	3.7 ± 0.4	3.6 ± 0.4	3.8 ± 0.4	3.8 ± 0.3
% RELATIVES	Fat mass	22.4 ± 6.8%	22.2 ± 7.5%	25.2 ± 8.85%	21.6 ± 7.2%
	Muscle mass	49.1 ± 7.2%	48.1 ± 9.2%	48.6 ± 9.9%	49.9 ± 6.9%
DERIVED	Σ 6 skinfolds (mm)	56.1 ± 30	49.6 ± 26	72.1 ± 41	55.3 ± 36.8
ANTHROPOMETRICS	Body nass index(kg/m* m)	24.0 ± 4.6	22.4 ± 3.7	25.0 ± 5.2	24.7 ± 6.2
	Muscle/bone index	4.0 ± 0.83	3.81 ± 0.44	3.92 ± 0.59	4.18 ± 1.04
	Fat/muscle index	0.47 ± 0.19	0.46 ± 0.09	0.53 ± 0.16	0.46 ± 0.24

All variables are expressed as a mean and standard deviation

Σ Six skinfolds: algebraic sum of triceps, subscapular, supraspinal, abdominal, medial thigh, and calf skinfolds. Body mass index: current weight/ height* hight.

Table 5. Comparaciones de composición corporal entre diferentes categorías de edad y según sexo

Variable	Cadet	Junior	Kiu Novicio	Senior	p-value*
Men	n = 45	n = 19	n = 21	n = 47	p-vaue
Fat mass	14.2 ± 4.9 a	14.3 ± 2.4 ab	18.8 ± 7.4 b	16.7 ± 6.1 ab	0.008
Muscle mass	30.7 ± 7.2 a	33.4 ± 7.3 ab	36.1 ± 10.4 ab	38.3 ± 9.4 b	0.001
Bone mass	8.0 ± 1.4 a	8.6 ± 1.4 ab	9.1 ± 1.9 ab	9.1 ± 1.9 b	0.013
Sum of folds	49.6 ± 26.0 a	46.9 ± 11.5 a	72.1 ± 40.7 b	58.8 ± 30.4 ab	0.014
Women	n = 19	n = 10	n = 8	n = 14	p-value
Fat mass	17.3 ± 7.4	20.8 ± 5.7	18.3 ± 3.8	18.6 ± 7.7	0.63
Muscle mass	24.9 ± 6.7	29.2 ± 6.1	26.2 ± 7.6	28.7 ± 7.0	0.29
Bone mass	6.5 ± 1.8	7.5 ± 1.2	7.1 ± 1.9	7.3 ± 1.9	0.37
Sum of folds	78.0 ± 32.7	101.1 ± 32.9	82.6 ± 19.2	92.4 ± 47.9	0.38

All variables are expressed as a mean and standard deviatio.

(*) Variance Analysis at a significance level of 0.05. For comparisons between pairs, we used the Bonferroni correction, where different lowercase letters indicate statistically significant differences between columns.

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