MORPHOLOGICAL PROFILE OF BRAZILIAN JIU-JITSU ELITE ATHLETES

EXERCISE AND SPORTS SCIENCES

ORIGINAL ARTICLE

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ABSTRACT

Athletes from many sports that are categorized by body mass tend to reduce it to fit in lower categories. Such reduction can compromise the athlete's performance and health. In order to determine the most appropriate category, the body composition is highly relevant, especially to avoid excessive reduction. Thus, this study analyzed the morphological profile of Brazilian Jiu-Jitsu elite athletes. The sample was composed of 11 athletes, aged 25.8 ± 3.3 years, medalists in national and/or international competitions. The analysis was performed to determine the anthropometric body composition and somatotype. Body fat percentage from this population was 10.3 ± 2.6 % fat, a high percentage of muscle mass (61.3 ± 1.5 %), and predominant mesomorphic component (5.5 ± 1.0) was observed. The points of highest and lowest fat accumulation were respectively abdominal (15.7 ± 6.3 mm) and chest (6.8 ± 1.5 mm) regions. It can be concluded that athletes from this sport showed higher body mass during the preparatory period than in competitive conditions (4.4 ± 2.4 %); however, they showed low body fat, high muscle mass percentage and predominant mesomorphic component.

Keywords: high performance, anthropometry, physical evaluation.

INTRODUCTION

It is crucial to know the body composition in combat sports modalities in order to control and define the weight category. Moreover, higher body fat percentage is negatively correlated with performance in locomotion and technical entrance activities[1,2]. Some studies distinguish different competitive levels in athletes concerning their body composition, reporting that athletes of lower competitive level present higher fat mass percentage[3]. Thus, the maximization of the lean mass percentage within the upper threshold of a weight category could provide advantages to an athlete on his/her physical performance[4].

In order to fit in a given category, many athletes of combat sports modalities adopt weight loss[5-8], making use of different methods and can refer to caloric restriction, hydric restriction, dehydration by saunas, running wearing clothes which decrease heat exchange with the environment, use of plastic outfits, use of diuretic, laxative and/or stimulating medication, as well as vomiting induction. These methods can cause decrease in physical performance, negatively affect the cognitive aspect, damage health and even cause death[6,9,10].

Many studies have tried to investigate the effects of the body mass reduction on performance[11-15], the anthropometric alterations[8,12,15], the humoral responses[7,16,17], the cognitive effects[9] and physiological responses[11], differentiating the reduction method into gradual and fast[18,19].

Since the Brazilian Jiu-Jitsu is a sport in which the athletes are divided in nine weight categories, besides the category termed absolute[20], they use body mass reduction to fit in the upper threshold of a given category. Steen and Brownell[21], in a study with North-American Olympic wrestling athletes (n = 63), mentioned that 41% of the athletes reported weight fluctuations from 5.0 to 9.1kg in one week. Brito et al.[22] investigated 120 Brazilian Jiu-Jitsu fighters (14 women and 106 men) aged 21.4 ± 5.3 years, in pre-competitive season, and identified that 29% of them adopted some kind of fast reduction of pre-competition body mass. However, until the present moment no indication of the magnitude of body mass reduction in Brazilian Jiu-Jitsu athletes has been found in the literature.

Generally speaking, the athletes of domain combat sports modalities have presented body fat below the population mean [4,16,23]. Specifically concerning Brazilian Jiu-Jitsu, Del Vecchio et al.[24] reported that the modality's athletes (n = 7) presented values of 9.8 ± 4,2% of body fat.

Besides the body composition in the fight modalities, Carter and Heath[25] suggest that the somatotype and sports success are positively correlated. In combat sports modalities, the mesomorphy component has been highlighted as the most relevant for performance[4,26], allowing in fact identifying athletes of different performance levels[27]. Nevertheless, little is known about the somatotypology in Brazilian Jiu-Jitsu athletes and only one study[24] which reported predominant mesomorphic component in this population was found (n = 7; 7.9 ± 1.4).

Considering the previous information and since Brazilian Jiu-Jitsu is not a sport extensively studied concerning anthropometric aspects, the present study had the aim to analyze the morphological profile presented by elite athletes of this sport.

METHODS

Sample

The sample of this research was composed of 11 male elite Brazilian Jiu-Jitsu athletes, aged 25.8 ± 3.3 years, from the male

adult category, with brown and black belt graduations. In order to fit into this group, they have been medalists in national and/or international competitions. Out of these athletes, one was from the feather category (up to 67kg), four from the light category (up to 73kg), three from the middleweight category (up to 79kg), two from the heavy category (up to 91kg), and one from the super heavy category (up to 97kg).

All subjects, after having been informed about the procedures to which they would be submitted to, signed a Free and Clarified Consent Form. Subsequently, data were collected in the Laboratory of Exertion Physiology (LABFISE) of the State University of Maringá (UEM), between August 1st and 17th September, 2008. In that period, the athletes were in preparation season. This work research was approved by the Permanent Ethics in Research with Humans Committee (COPEP) of the State University of Maringá, legal resolution # 175/2007.

Measure instruments

The athletes had their weight (body mass) checked on a Filizola® scale with 0.1kg precision, and height was determined on a Seca® stadiometer with 0.1cm precision, according to protocol by Lohman et al.[28]. After the weight and height values were set, the body mass index (MBI) was determined by the use of the body mass/stature^2 quotient (kg/m^2).

The thorax, waist, abdomen, hip, forearm, thigh and leg perimeters were obtained following the techniques described by Lohmanet al.[28], except for the relaxed arm perimeters, in which the widest circumference and perimeter of the relaxed arm were considered, which were measured on the point of biggest volume, at the end of a maximum biceps voluntary contraction. All perimeters were determined with a Seca® measuring tape with 0.1cm precision. The bone diameters of the femoral bicondyle and humeral bicondyle were obtained with a pachimeter with 0.1cm precision, according to the description by Lohmanet al.[28].

The skinfolds were determined (chest, mid-axillary, tricipital, subscapular, abdominal, suprailiac and mid-thigh) three times, using the mean value, following standardization by Lohman et al.[28]. The Harpenden plicometer (John Bull British Indicators®, England) with constant pressure of 10g/mm and 0.2mm precision was used.

From the skinfolds thickness, the body density (BD) was determined by the formula by Jackson and Pollock[29]:

$$BD = 1.11200000 - 0.00043499\ (\sum 7SFT) + 0.00000055\ (\sum 7SFT)^2 - 0.00028826\ (AGE)$$

where ∑7SFT is the sum of the thickness of seven skinfolds (chest, mid-axillary, tricipital, subscapular, abdominal, suprailiac and thigh).

Once the body density was set, the Siri equation[30] was used for body composition estimation:

$$\%F = [(4.95/BD) - 4.50] \times 100$$

Where %F is the body fat percentage.

Muscle mass (MM) was estimated by the equation proposed by Martin et al.[31]:

$$MM\ (g) = H\ (0.0553 \cdot P_T^2 + 0.0987 \cdot P_{FA}^2 + 0.0331 \cdot P_C^2) - 2.445$$

Where H is height, P_T is the thigh perimeter corrected by the thigh skinfold thickness, P_{FA} is the forearm perimeter and P_C is the calf perimeter corrected by the skinfold thickness of the mid-leg, and all measurements were in centimeters. The thigh and calf perimeters were corrected by subtraction of the values found by the π value multiplied by the respective skinfolds thickness.

The somatotype was obtained using the proposal by Carter and Heath[25] which considers body mass, stature, bone diameters (humeral and femoral bicondyles), perimeters (contracted arm and mid-leg), and skinfolds thickness (tricipital, subscapular, suprailiac and mid-leg).

STATISTICS ANALYSIS

The data obtained were statistically analyzed in the Excel® program and presented as mean, standard deviation (SD), mean standard error of the mean(SEM), confidence interval of 95% (CI95%) and amplitude (minimum and maximum values).

RESULTS

The anthropometric characteristics of the Brazilian Jiu-Jitsu athletes are presented in table 1. The great variations concerning body mass (83.1 ± 8.7kg) and stature (180.1 ± 6.5cm) are mainly due to the different competitive categories of these athletes.

The results indicated low body fat level; however, with great variation between the extreme values. The points of highest and lowest accumulation were the abdominal and chest regions, respectively. The athletes presented mesomorphic component and high muscle mass percentage.

DISCUSSION

Body composition is an essential component for the control and definition of the weight categories in combat sports modalities. However, few studies have investigated the morphological profile of Brazilian Jiu-Jitsu athletes. Thus, the main difficulty when analyzing the results found in studies with Brazilian Jiu-Jitsu fighters is the lack of indicators in studies published in indexed journals. Therefore, due to this limitation, data obtained in similar modalities (judo and Olympic wresting) were used to perform possible comparisons.

Another difficulty in the data analysis is that there is no homogeneity concerning the training period of the athletes, the equation for estimation of the body density, the equation for estimation of body fat percentage and, whenever the skinfolds thickness method was adopted, the kind of calipers.

However, concerning the method of body composition measurement, the majority of the studies uses the skinfolds thickness method for body density estimation. This study adopted the Jackson and Pollock[29] equation, originally developed for individuals aged between 18 and 61 years. Although this equation is has not been sensitive to identify slight alterations in body composition of judo fighters submitted to weight loss[32], it has been widely used in studies with combat sports modalities athletes[4,26] and other athletes[33,34].

Despite these limitations, a comparison of the results of this study with results obtained in other studies involving fighters is presented in table 2.

The results found are in agreement with previous studies whi-

Table 1. Anthropometric characteristics of Brazilian Jiu-Jitsu athletes (n = 11).

Variable	Mean	SD	SEM	CI95%	Amplitude
Body mass (kg)	83.1	8.7	2.6	78.0-88.3	71.6-99.8
Height (cm)	180.1	6.5	2.0	176.3-183.9	172.0-191.0
BMI (kg/m^2)	25.6	1.5	0.5	24.7-26.5	23.1-27.4
%Fat	10.3	2.6	0.8	8.8-11.9	5.0-13.8
FM (kg)	8.7	2.8	0.8	7.0-10.3	4.0-12.9
LBM (kg)	74.4	6.9	2.1	70.4-78.5	64.7-87.8
LM (kg)	51.9	5.1	1.7	48.6-55.3	46.1-60.9
%LM	61.3	1.5	0.5	60.3-62.3	58.8-63.4
SFT (mm)					
Abdominal	15.7	6.3	1.9	12.0-19.4	5.6-27.0
Mid-axillary	8.5	2.4	0.7	7.0-9.9	5.4-12.4
Thigh	11.5	3.0	0.9	9.8-13.3	6.5-15.5
Subscapular	13.8	3.0	0.9	12.1-15.6	8.2-18.2
Suprailiac	9.5	4.1	1.2	7.1-11.9	4.8-17.0
Chest	6.8	1.5	0.4	5.9-7.7	4.2-9.6
Tricipital	8.5	2.9	0.9	6.8-10.8	5.6-16.2
∑7SFT	74.4	18.0	5.4	63.8-85.0	42.6-102.3
Mean of 7SFT	10.6	2.6	0.8	9.1-12.1	6.1-14.6
Perimeters (cm)					
Thorax	101.2	4.9	1.5	98.1-104.2	91.0-109.0
Waist	84.1	4.9	1.5	81.2-87.0	75.5-91.0
Abdomen	83.9	5.3	1.7	80.6-87.1	78.0-93.0
Hip	100.3	4.1	1.2	97.9-102.7	95.0-100.0
Arm	34.9	1.5	0.5	34.0-35.8	33.0-38.0
Forearm	29.8	1.0	0.3	29.2-30.5	28.5-31.0
Thigh	58.9	2.6	0.8	57.3-60.5	55.0-62.5
Leg	37.4	2.5	0.8	35.8-38.9	32.3-41.0
Diameters					
Humeral bicondyle	7.1	0.2	0.1	7.0-7.3	6.8-7.5
Femoral bicondyle	9.9	0.4	0.1	9.6-10.2	9.0-10.2
Somatotype					
Endomorphy	3.0	0.8	0.3	2.5-3.5	1.7-4.5
Mesomorphy	5.5	1.0	0.3	4.9-6.1	3.4-7.0
Ectomorphy	1.7	0.6	0.2	1.4-2.0	0.8-2.4

SD = standard deviation; SEM = standard error of the mean; CI 95% = confidence interval of 95%; BMI = body mass index; FM = fat mass; LBM = lean body mass; LM = lean mass; SFT = skinfold thickness; ∑7SFT = sum of skinfold thickness of seven skinfolds.

ch state that domain combat practitioners present fat percentage below the population mean[4,16,23]. When the athletes in this study are compared with studies involving Brazilian Jiu-Jitsu fighters and others from similar modalities, it can be observed that they are within the mean presented by this population, and the lowest and highest values of fat percentage were 7.3%[16] and 15.0%[14], respectively. When the Brazilian Jiu-Jitsu athletes are analyzed in isolation, great similarity is found in the obtained results in comparison with those reported by Del Vecchio et al.[24] (~10%).

Divinding the athletes from the same nationality[1,2,24], with the purpose to discard possible ethnic differences, similarities between the results in this study and in the study by Del Vecchio et al.[24] and Franchini et al.[2], were found; however, with discrepancy when compared with the judo fighters from the college judo team (n = 13; ~14%)[1].

The point of highest fat accumulation in the present sample was the abdominal region. Elite judo fighters (n = 43; 15.8 ± 11.5mm) and non-elite ones (n = 93; 15,4 ± 10,7mm)[38] presented similar values in addition to have presented the abdominal region as the point of highest body fat accumulation. Such fat accumulation in the central region is common in the male gender, which presents the android model as fat distribution characteristic, especially concerning hormone characteristics[39].

The BMI analyzed in isolation classifies the athletes as presenting overweight. However, this classification is not the best to be used for athletes, since only considers body mass and stature and does not identify the body composition constituents. Predominant values of high muscle mass and low body fat level mesomorphy indicate that this high BMI is a product of remarkable muscle mass development found in fighters of the present study.

Carter and Heath[25] suggest that somatotype and sports success are positively correlated. In domain combat sports modalities, the mesomorphy component has been highlighted as the most relevant for performance[4,26], allowing also the discrimination of athletes of different performance levels[27]. Therefore, our results concerning somatotype indicate that Brazilian Jiu-Jitsu fighters present predominant mesomorphic component.

A somatotipological comparison between the results in this study and others involving fighters is illustrated in table 3.

When the result in this study is compared with other studies involving Brazilian Jiu-Jitsu fighters and fighters of similar modalities (judo and Olympic wrestling) it can be seen that the athletes in this study presented the highest mesomorphic component value. In the other studies, the lowest mesomorphy value found was 5.6 in judo fighters from a lighter category (n = 18)[40]; conversely, the highest value was 7.9 in Brazilian Jiu-Jitsu athletes (n = 7)[24].

The athletes were evaluated in preparatory season, and it was observed that all of them were above the upper threshold of body mass in their categories (4.4 ± 2.4%), with amplitude range between 1.0% and 9.2%. These values are compatible with what was reported in other modalities such as Olympic wrestling[6,21,42]. The fact that the athletes were above the upper threshold of the competitive category deserves attention, since fast decrease in body mass in order to fit in their categories may bring damage to health[43] and harm performance[44], especially due to the fact that these athletes present fat mass compatible with the indications for fighters and predominant mesomorphic component. Thus, strategies that restrain remarkable reduction which were successful in other combat sports modalities[45,46] should be implemented among high performance Brazilian Jiu-Jitsu athletes. In addition to that, further investigation is necessary in order to identify the profile of athletes of this modality, since there is a low number of studies involving Brazilian Jiu-Jitsu[22,24,47].

CONCLUSION

It can be concluded that the elite Brazilian Jiu-Jitsu athletes present fat mass percentage within the recommendation for this population, high muscle mass and predominant mesomorphic component. Although the elite Brazilian Jiu-Jitsu athletes present this morphological profile, since the training period corresponds to the preparatory season, they presented body mass higher than the upper threshold of their competitive categories, indicating hence the need to refer to body mass reduction in order to fit in their competitive categories.

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Table 2. Body composition in fighter of different studies (values presented in mean ± standard deviation).

Reference	Athletes	N	Age (years)	Body mass(kg)	% Fat mass	Training phase	Method	Body density (equation)	% Fat (equation)	Calipers
Present study	Elite Brazilian Jiu-Jitsu athletes	11	25.8 ± 3.3	83.1± 8.7	10.3 ± 2.6	P	SFT	Jackson; Pollock	Siri	Harpenden
Del Vecchio et al.[24]	High-performance Jiu-Jitsu fighters	7	25.3 ± 2.9	78.9 ± 12.2	9.8 ± 4.2	NR	SFT	Guedes; Guedes	NR	NR
Barbas et al.[23]	Elite Greek wrestlers	12	22.1 ± 1.3	72.1 ± 3.6	7.6 ± 0.9	NR	SFT	Jackson; Pollock	Siri	Harpenden
Franchini et al.[1]	Brazilian College Judo team	13	NR	89.0 ± 16.0	13.7 ± 5.2	NR	SFT	-	Drinkwater; Ross	Harpenden
Franchini et al.[2]	Official Brazilian Judo team	7	25.6 ± 4.0	90.6 ± 23.8	11.4 ± 8.4	PC	SFT	Jackson; Pollock	NR	Harpenden
	Second Brazilian Judo team	15	25.5 ± 4.6	86.5 ± 16.3	10.1 ± 5.7	PC	SFT	Jackson; Pollock	NR	Harpenden
Degoutte et al.[14]	French Judo fighters of national level	10	NR	74.7 ± 6.7	14.9 ± 3.0	PC	SFT	Durnin; Rahaman	NR	Harpenden
	French Judo fighters of national level	10	NR	72.1 ± 1.4	15.0 ± 1.0	PC	SFT	Durnin; Rahaman	NR	Harpenden
Kraemer et al.[16]	College North-American wrestlers	12	19.3 ± 1.2	75.3 ± 2.5	7.3 ± 0.7	NR	SFT	Jackson; Pollock	Siri	Lange
Callister et al.[35]	North-American elite Judo fighters	18	24.4 ± 0.9	83.1 ± 3.8	8.3 ± 1.0	PC	SFT	Jackson; Pollock	-	Lange
Vardar et al.[36]	National Turkish wrestling team	8	17.3 ± 0.9	73.2 ± 17.7	9.7 ± 6.3	PC	BIO2F	-	-	-
Thomas et al.[37]	Canadian Judo national team	22	24 ± 4	75.4 ± 12.3	9.3 ± 2.1	PC	SFT	-	Lohman	Lange

NR = not reported; SFT = skinfold thickness; BIO2F = two-feet bioimpedance; PC = pre-competitive; P = preparatory.

Table 3. Somatotipological comparison between fighters of different studies. (Values presented in mean ± standard deviation).

Reference	Athletes	N	Age	Body mass(kg)	Endomorphy	Mesomorphy	Ectomorphy	Training phase
Present study	Elite Jiu-Jítsu athletes	11	25.8 ± 3.3	83.1± 8.7	3.0 ± 0.8	5.5 ± 1.0	1.7 ± 0.6	P
Del Vecchio et al.[24]	High-performance Jiu-Jitsu athletes	7	25.3 ± 2.9	78.9 ± 12.2	3.2 ± 1.6	7.9 ± 1.4	1.6 ± 0.6	NR
Claessens et al.[40]	Elite judo fighters up to 71kg	18	24.9 ± 4.0	65.7 ± 4.3	2.3 ± 0.4	5.6 ± 0.5	1.9 ± 0.4	PC
	Elite judo fighters 71-86kg	9	25.2 ± 4.7	81.2 ± 3.7	3.0 ± 0.5	6.0 ± 0.7	1.7 ± 0.7	PC
	Elite judo fighters above 86kg	11	25.8 ± 3.6	108.3 ± 15.1	4.1 ± 0.9	6.2 ± 0.6	1.3 ± 0.4	PC
Farmosi[41]	Hungarian judo fighters up to 71kg	7	22.0 ± 3.8	66.7 ± 3.7	2.5 ± 0.5	6.6 ± 1.3	1.8 ± 1.0	NR
	Hungarian judo fighters above 71kg	11	21.2 ± 2.0	90.5 ± 18.4	4.3 ± 2.1	7.2 ± 1.6	1.4 ± 0.7	NR

NR = not reported; P = preparatory; PC = pre-competitive.

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