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The Correlation of Anthropometric Variables and Jump Power Performance in Elite Karate Athletes

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ABSTRACT

Spigolon D, Hartz CS, Junqueira CM, Longo AR, Tavares V, Fayçal H, Paula M, Jacinto LC, Moreno MA. The Correlation of Anthropometric Variables and Jump Power Performance in Elite Karate Athletes. **JEPonline** 2018;21(1):139-148. The purpose of this study was to evaluate the relationship between the anthropometric variables and the power jump capacity in elite athletes of the Karate modality. Fifty-one elite Karate athletes from both genders (22 ± 5 yrs old) performed two evaluations: (a) Anthropometric variables that were used to obtain body composition; and (b) Vertical jumps tests to quantify jump power. For analysis of the relationship between the variables, Pearson Linear Correlation Coefficient was used. The findings indicate that there was a low but significant correlation between weight and power of the jump, a high significant inverse correlation between percentage of body fat and power of the jump, and a moderate significant correlation between fat free mass and power of the jump. These findings suggest that body composition presents an influence on the athletes' capacity of power jump, and it can be used as a tool to guide the technical aspects of the training process to help improve karate performance.

Key Words: Athletic Performance, Body Composition, Muscle power, Vertical jump

INTRODUCTION

Karate-Do consists of a Japanese millenary martial art, which in your competitive context, could be characterized as a semi-contact modality. According to the World Karate Federation (WKF), Karate is divided into two classes that consist of the kata (demonstration) and kumite (fighting). Both groups are classified into individual categories by gender, age, and weight. Division of the cadet category (14 and 15 yrs) is -47 kg, -54 kg, and +54 kg for the female gender, and -52 kg, -57 kg, -63 kg, -70 kg, and +70 kg for the male gender. In the junior category (16 and 17 yrs), -48 kg, -53 kg, -59 kg, and +59 kg for the female, and -55 kg, -61 kg, -68 kg, -76 kg, and +76 kg for the male. In the under 21 yrs and senior are -60 kg, -67 kg, -75 kg, -84 kg, and +84 kg for the male, and -50 kg, -55 kg, -61 kg, -68 kg, and +68 kg for the female. Currently, the competitive level of karate has increased exponentially, which has generated a greater professionalism of the modality. Also, the importance of the sport is acknowledged by the International Olympic Committee that recognizes karate as an Olympic modality with its first presentation in the upcoming Tokyo 2020 Olympic Games.

Knowledge about both the characteristics of the modality and the factors that are related to a better performance is necessary for the development of Karate. With respect to the athletes' physiological demands, kumite is considered a modality with a high physiologic requirement of the athlete due to the intense and high volume of training and competitions (12). Also, the movements used in the sportive gestures are characterized by rapid accelerations and decelerations. These specific characteristics of the modality associated with low time for execution and short-term recovery during the athletes' combat (2,5) require a greater use of power, strength, speed, and resistance (4,20).

In relation to the athletes' energy demands during a competitive event, a high aerobic capacity is important to avoid fatigue and facilitate recovery between the confrontations. On the other hand, anaerobic capacity (6) is also important in that it plays a critical role in the athletes' performance. In fact, it correlates highly with the athletes' maximum speed and explosive strength (11), which are fundamental capacities for excellence in karate.

With regard to which power is a determining factor for a better athletic performance in various sporting modalities (6,15,17,28), Loturco and colleagues (13) showed that, in particular, the lower member power have a positive correlation with the capacity of execution of kicks and punches in karate. In addition, in individual sports of fights, subdivided into weight categories, the management of body composition is fundamentally important for performance. Prediction and control of these variables are related to the increase in physical conditioning, through the improvement in the athletes' aerobic capacity, anaerobic capacity, and movement mechanics (22).

In athletic modalities that require fast movements and a constant change in direction and jumps, body composition can influence movement patterns and execution of specific skills. This is especially the case with athletes who have a higher proportion of body fat. The increase in body overload tends to reduce the athletes' performance in strength oriented movements (7).

Ribeiro and colleagues (24) evaluated the correlation between body composition and vertical jump performance in basketball athletes that are required to execute power movements. The authors' findings confirm the relationship between these variables. They also suggested that the body composition can be considered as a predictor of the power performance in these athletes.

Given that the data regarding body composition in karate is scarce, it is necessary to carry out research in this area to better understand the influence of body composition on the performance in karate athletes. Therefore, the purpose of this study was to evaluate the relationship between the anthropometric variables and the power jump capacity in elite athletes of the Karate modality.

METHODS

Subjects

This study followed the recommendations for experimental research with humans. It was approved by the Ethics in Research Committee of the Institution with the number 100/2015. Fifty-one Karate athletes from both genders, 22 ± 5 yrs old, were selected to take part in the study. Twenty-three were female, 28 were male, and both genders were well-trained athletes with active participation in national competitions. The inclusion criteria consisted of the following: (a) to be competing at the national level; (b) to be a professional athlete for at least 2 yrs; (c) to perform at least 4 weekly training sessions of the sport; (d) to be among the top three in the state ranking in their specific category. The study excluded athletes who had osteomioarticular injuries that made it impossible to execute the experimental protocol.

Procedures

All the subjects were submitted to two evaluations. The first one consisted of an evaluation of the athletes' anthropometric variables to obtain the body composition. The second evaluation consisted of tests to quantify the athletes' jump power through the vertical jumps.

Evaluation of Anthropometric Variables

For the evaluation of the anthropometric measurements, the subjects' body weight was measured with a digital scale (Filizola®) with a capacity of 0.1 to 200 kg while wearing the minimum clothing. Height was measured in meters obtained by a fixed stadiometer (Sanny®) with a scale of 0.1 to 2.2 m. Body mass index expressed in $kg \cdot m^{-2}$ was obtained by the ratio between body mass and squared from the stature. To measure cutaneous skin folds, a trained nutritionist used a scientific adipometer (Lange Skinfold Caliper®). All measurements were obtained on the right side of the body. After triplicate measurements, the mean of the three measurements was used for analysis. For body density estimation, an equation for prediction was used according to the gender of the subjects. For the female subjects (10), the following skinfolds were used: tricipital, suprailiac, abdomen, and thigh. For the male subjects (9), the Jackson and Pollock prediction equation was used: pectorals, middle axillary, triceps, subscapular, abdomen, suprailiac, and thigh. The conversion of body density to fat percentage (%) was obtained by the Siri equation (27), which also considered the gender factor. Conversion of % body fat = [(4.95 / DC) -4.50] x 100 for male athletes, and % body fat = [(5.01 / DC) -4.57] x 100 for female athletes (27) was carried out. Body fat in kg was obtained by the equation: Weight (kg) of fat = % of fat x total body weight / 100. Fat free mass (23) was obtained by the calculation = total body weight (kg) - body fat weight (kg).

Evaluation of Vertical Jump Test

Two vertical neuromuscular tests were performed, one of them without counter-movement, Squat Jump (SJ), and the other performed with countermovement, Countermovement jump (CMJ). (1) **Squat jump** – **SJ**: Consisted of a jump in which the athlete performed isometric muscular action when pushing the jump from the initial position of the half-flexion (standing with hands at the hips and total extension of the knees) for the purpose of jumping higher and at the highest possible speed; (2) **Countermovement jump** – **CMJ**: Executed in a similar way to SJ, however, the athlete performed a descent movement that was followed by the extension of the lower limbs, without pause, favoring the amplitude of the countermovement. For the evaluation of both tests of the vertical jumps, 3 attempts were performed with an interval of 15 sec between each. The interval break between jumps was 3 min. The height of the jump was evaluated through the contact platform Elite Jump, which was previously validated for evaluation of vertical jumps (14).

Statistical Analyses

For the analysis of the relationship between the variables, the Pearson's Linear Correlation Coefficient was used with significance level of 5%. The degrees of correlation used were proposed by Mukaka (19) who considers the correlation index insignificant when it is between 0 and 0.3, low between 0.3 and 0.5, moderate between 0.5 and 0.7, high between 0.7 and 0.9, and very high between 0.9 and 1. All statistical procedures were performed by the SPSS application version 20.0.

RESULTS

Table 1. Characteristics of Subjects.

Variables	N = 51
Age (yrs)	19 ± 5
Body Mass (kg)	67 ± 13
Height (m)	1.7 ± 0.3
Fat Free Mass (kg)	56.4 ± 13.5
Percentage of Fat (%)	13.3 ± 7.9
CMJ (cm)	37.1 ± 7.8
SJ (cm)	34.2 ± 6.9

Figure 1 presents the results of the correlation between the weight (kg) and the CMJ and SJ, indicating a significant low correlation between the variables.

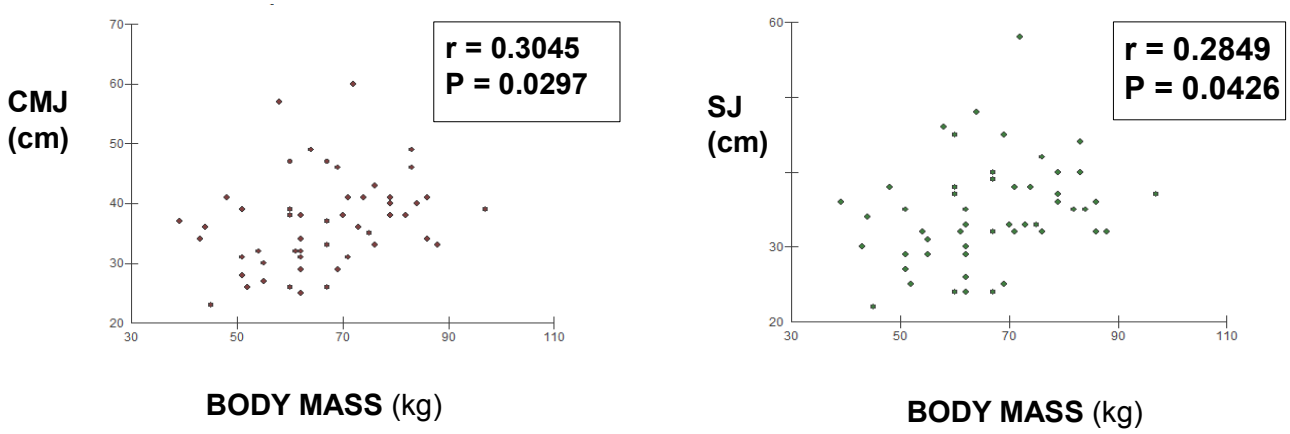

Figure 1. The Relationship between Power (cm) and Body mass (kg).

Figure 2 presents the results of the correlation between body fat (%) and CMJ and SJ, indicating a significant moderate and high negative correlation between the variables.

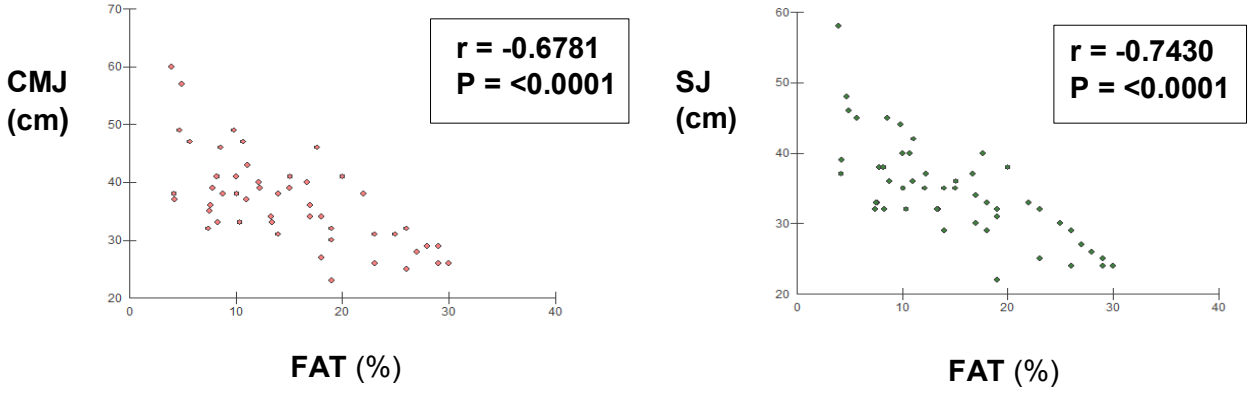

Figure 2. The Relationship between Power (cm) **and Fat Mass** (%)**.**

Figure 3 presents the results of the correlation between the lean mass (kg) and the CMJ and SJ, indicating a moderate significant correlation between the variables.

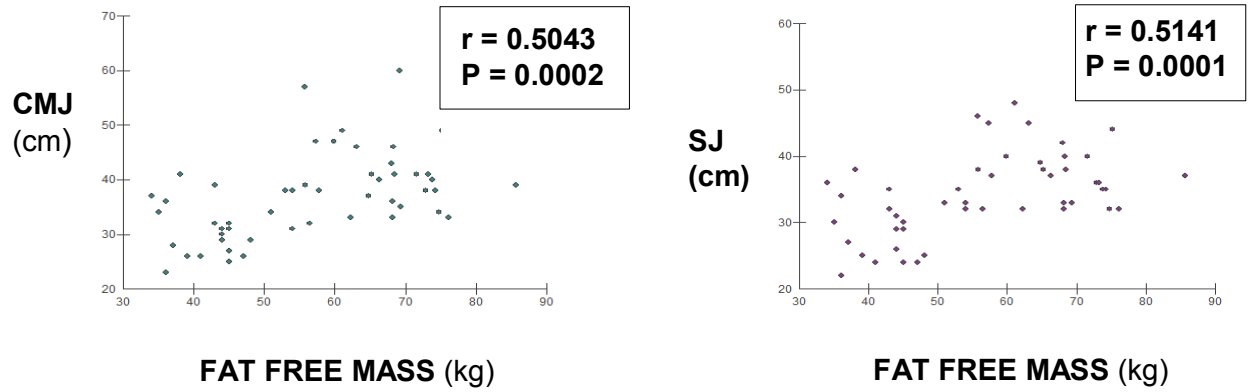

Figure 3. The Relationship between Power (cm) and Free Fat Mass (kg).

DISCUSSION

The results of this study indicated a low significant correlation in the comparison between the weight and the power of the jump, a high significant inverse correlation in the comparison between the percentage of body fat and the power of the jump, and a moderate significant correlation between fat free mass and the power of the jump.

Body composition may be one of the limiting components in athletic performance, especially in athletes that practice combat modalities (6). This consideration becomes an extremely relevant factor, especially because these modalities are subdivided by categories of body weight. On the other hand, it is both interesting and disturbing that so few studies have examined the influence of body composition on athletic performance. There is concern as to the influence of body composition on professional athletes. More research should develop sport-specific reference values to help guide the athletes' training.

When we observed the results of the present study, the athletes' correlation of body weight with the power of the jump is low but significant. In contrast, the inverse correlation between the percentage of body fat and power is high. The responses suggest that athletes with higher fat percentages achieve lower jump power, and the moderate correlation of fat free mass and jump power indicates how much higher the fat free mass will influence power capacity. These correlations confirm the hypothesis that body weight should not be the only variable analyzed in the evaluation and monitoring of the athletes, since the optimization of body composition can play an important role in athletes' performance.

Our findings corroborate the findings of previous studies (1,18,21,24) that verify the relationship between body composition, anthropometric variables, and power capacity in athletes of basketball, handball, and volleyball modalities. These studies indicate that athletes with low body fat composition and greater muscle mass present higher power performance, which this necessary for excellence in sports performance in these modalities.

Franchini and colleagues (8) evaluated elite athletes of different categories in judo modality, and verified that the elevation of body fat mass resulted in the athletes' performing at a lower competitive level. The same response was observed by Andreatto and colleagues (3), who evaluated the morphological profile of Jiu-Jitsu athletes. They observed that the higher fat percentages had a negative influenced on the athletes' locomotion activities and the execution of Jiu-Jitsu specific movements. These studies corroborate our findings, thus pointing to the relationship between body composition and decrease in performance in fight athletes.

Silva and colleagues (26) investigated the relationship between body composition and strength capacity in karate athletes. They reported that the parameters associated with the increase in adiposity were inversely related to the force variables. Collectively, these studies indicate that the greater proportion of fat mass the greater the negative influence on the force capacity, which is important since force is a parameter that generates a direct influence on power.

Given the observed correlation between body composition and jumping power performance in the present study, the data reinforced the suggestion that monitoring of body composition

should be carried out to optimize the athletes' physical and technical performance in karate. Assessment of lower limb power used in this study by the vertical jumps SJ and CMJ are often evaluated to analyze and monitor the neuromuscular performance of elite athletes (15). Furthermore, the jump power variables showed correlation with punch velocity in karate modality, so when higher the jump power, higher the velocity in the punch (13), fortifying the importance of these evaluations for the ideal monitoring and training in karate.

Body mass with a predominance of a greater quantity of fat free mass is associated with a lower percentage of fat, which is a positive association in sports that require explosion and power capacities (25), especially in karate where the body weight is a determining factor in the subdivision of categories. As indicated by our findings, monitoring of the anthropometric variables can contribute positive information regarding the athletes' execution of strategies that optimize body composition as well as training that favors the athletes' preparation for competition, power, and performance.

CONCLUSIONS

The findings in the present study indicate that body composition is correlated with power performance in karate athletes. The athletes with lower muscle mass and higher body fat obtained worse performance in lower limb power. Hence, to avoid the bad performance outcomes, an evaluation of anthropometric variables can be as a tool to guide the technical aspects of the training process. The evaluation can also help in the preparation for adequate training program for the karate athletes.

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