

## Characterization of the anthropometric profile and handgrip strength of karate athletes during an in-person official championship of the Japan Karate Association (JKA), Brazil

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### Abstract:

**Background:** Martial arts, such as karate, are millennial forms of combat currently modified into combat sports, which had their power to promote health and physical and psychological well-being fairly established along their trajectory. This study aimed to document the anthropometric and the handgrip strength profile of high-performance Shotokan karate athletes

**Materials and Methods:** Twenty athletes of both sexes were evaluated, of whom 65% were medalists in the Brazilian Championship of the Japan Karate Association (JKA). Body composition was obtained by doubly indirect methodology, adopting anthropometric equations using skinfold measurements and fitness based on handgrip strength assessed with a dynamometer.

**Results:** The athletes presented, on average, age of 30.3 (8.7) years and fat percentage of 22.0 (6.8)% statistically significant differences were noticed between men and women for all analyzed variables, except fat percentage and fat mass.

**Conclusion:** This was the first study to record body composition and fitness after over 2 years without in-person competitions for the profile of high-performance karate athletes.

**Key Word:** Martial Arts. Muscle Strength Dynamometer. Body Composition. Athletic Performance. Karate. COVID-19.

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### I. Introduction

Martial arts (judo, karate, taekwondo, wrestling etc) are millennial forms of combat, modified into modern sport, which have been established for their power to promote health and physical and psychological well-being throughout life (Valdés-Badilla et al, 2022). Karate, or the way of the empty hand, is one of the Japanese versions of the art of unarmed combat, and Gichin Funakoshi (1957 – 1969) was the founder of the major modern style: Shotokan. Traditional training consists in practicing three skills: 1. Kihon involves basic techniques such as punching, kicking, blocking and attacking, which are performed either in a static stance or in movement in diverse stances (bases); 2. Katas are series of forms in a pre-established sequence of defense and attack techniques in movement, and 3. Kumite or fight includes defense and attack techniques in free movement against an opponent (Rossi, Tirapegui, 2007; Rossi, Tirapegui, 2015).

The Japan Karate Association (JKA) is a karate association that was founded in November 1948. On April 10, 1957, JKA became a legal entity when the Japanese Ministry of Education officially recognized it as “association of members for the promotion of karate and the spread and enrichment of actual karate practice” (JKA, 2022). On May 01, 1997, the Nihon Karate Kyokai (NKK)/Japan Karate Association (JKA) was created in Brazil, led by the Masters Yasuyuki Sasaki (in memoriam) and Yoshizo Machida; since then, it has been the only representative organization legally accredited by the worldwide headquarter (Kouraku, Tokyo, Japan) for Shotokan karate teaching and research (JKA Brasil, 2022).

The aim of the present study was to document the anthropometric and the handgrip strength profile of high-performance Shotokan karate athletes, during the first post-pandemic national JKA championship in Brazil, for comparing and monitoring the evolution of athletes both retrospectively and prospectively.

## **II. Material And Methods**

This study was characterized as field research with in-person data collection during the XXI Brazilian Championship 2021 of the Japan Karate Association (JKA), held in Goiânia – Brazil. Participants in this event were 410 athletes from 15 different Brazilian states; since 2019 this was the first in-person national event after COVID-19 pandemic.

During the technical course, the athletes were invited to take part in the present study. After verbal invitation, 20 Shotokan karate athletes of both sexes joined in; of these, n=11 (55%) were men, competing in the modalities fight (Kumite) and movement (Kata). As post-competition result, 65% (n=13) of the 20 athletes podiumed in the contested categories, which evidences the technical-competitive quality of this sample.

Anthropometric and handgrip strength evaluations were conducted before the competitive period at the facilities of Rio Vermelho Gymnasium in Goiânia; after explanation about the development and aims of the research, the athletes signed a free and informed consent term (TCLE), through an online form, according to UNIFIEO Ethics Committee approval (CAAE: 52059921.6.0000.5435).

The adopted inclusion criterion was high-level Shotokan karate athletes older than 18 years old, of both sexes, who registered to compete in the JKA-Brazil championship and accepted to sign the TCLE.

Body mass (BM: kg) was assessed with a digital portable scale, 0.1kg accuracy and 120kg capacity. Height (H: m) was obtained with an Avanutri® ultrasonic digital stadiometer, 1cm accuracy and 215cm capacity. The collected data were used to calculate body mass index (BMI: kg/m<sup>2</sup>) = body mass/height<sup>2</sup>, while nutritional status was classified according to WHO (2004).

To obtain fat percentage (%F), the following skinfolds in the right side of the body were measured with a Lange® caliper, 1mm accuracy and 60mm capacity: biceps (RB), triceps (RT), subscapular (RSe) and suprailiac (RSi). Then, %F was calculated by the equation of Durmin & Womersley (1974).

Muscle strength was assessed by the handgrip test which, according to the guidelines of the American College of Sports Medicine (ACSM, 2011) for health-related physical evaluation, is a reliable biomarker applicable in field data collection. A Jamar hydraulic hand dynamometer (2kgf accuracy and 90kgf capacity) was employed; such equipment is recommended by the American Society of Hand Therapists (ASHT) for assessments (Moureira et al, 2003). The athletes were instructed to remain comfortably sit on a chair without armrests, keeping the shoulder adducted, the elbow flexed at 90°, the forearm in neutral position, and the wrist between 0 and 30° extension (Dias et al, 2010). Subsequently, they were instructed to conduct the handgrip test with right maximum strength followed by left maximum strength; after three attempts, the highest magnitude was recorded (Reis, Azevedo & Rossi, 2009). To obtain total handgrip strength, the values for right and left hands were summed up (THGS: kgf); this procedure is adopted to minimize any interference in the individual handgrip strength due to dominance by one of the hands (ACSM, 2011).

Throughout data collection, good hygiene and sanitary practices were adopted in the anthropometric routine according to the post-COVID-19 pandemic flexibility for public events (Silva et al, 2021; Bagni et al, 2021).

### **Statistical analysis**

Continuous variables were descriptively analyzed by central tendency (mean) and dispersion (standard deviation) values. To detect statistical differences between male and female athletes, Wilcoxon non-parametric test was used, adopting 5% significance level to reject the Null Hypothesis (H<sub>0</sub>:  $\mu = 0$ ). For all analyses, the statistical software R Core Team was employed (2020).

## **III. Result**

Karate athletes participating in the Brazilian Championship of JKA had, on average, age of 30.3 (8.7) years, BMI of 25.3 (4.4) kg/m<sup>2</sup> and fat percentage of 22.0 (6.8)%; thus, they fell into the overweight category, according to WHO (2004). Anthropometric profile by sex is represented in Figure 1.

Figure: Characterization of the sample of male and female athletes participating in the XXI Brazilian Championship of the Japan Karate Association (JKA). Goiânia – Brazil, 2021

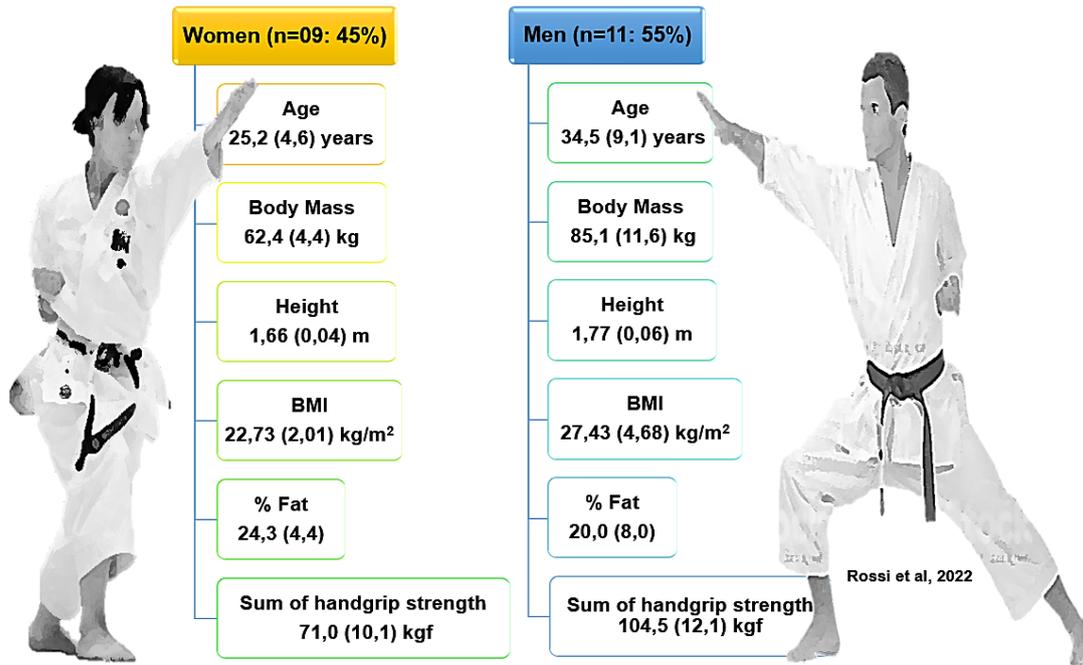


Figure 1: Kinanthropometric characteristics of male and female karate athletes.

Results of descriptive and inferential statistical analysis for the karate athletes are shown in Table 1. There were statistically significant differences between men and women for all analyzed variables, except fat percentage and fat mass (Table 1).

**Table 1:** Data from anthropometric evaluation and handgrip strength test of karate athletes participating in the JKA Championship, 2022. São Paulo. Brazil.

Variables	Mean (standard deviation)			p
	General n=20	Men n=11	Women n=09	
Age (years)	30.3 (8.7)	34.5 (9.1)	25.2 (4.6)	0.006
Body mass (kg)	74.9 (14.6)	85.1 (11.6)	62.4 (4.4)	< 10 <sup>-5</sup>
Height (m)	1.72 (0.08)	1.77 (0.06)	1.66 (0.04)	< 10 <sup>-4</sup>
BMI (kg.m <sup>-2</sup> )	25.3 (4.4)	27.43 (4.68)	22.73 (2.01)	0.006
Fat Percentage (%)	22.0 (6.8)	20.0 (8.0) <sup>#</sup>	24.3 (4.4)	0.08
Fat Mass (kg)	16.5 (6.6)	17.4 (8.4) <sup>#</sup>	15.3 (3.6)	0.24
Lean Mass (kg)	58.4 (12.2)	67.6 (8.3)	47.1 (2.9)	< 10 <sup>-7</sup>
RHGS (kgf)	46.4 (10.2)	53.3 (7.2)	37.9 (6.1)	< 10 <sup>-5</sup>
LHGS (kgf)	43.1 (10.4)	51.2 (5.4)	33.1 (4.4)	< 10 <sup>-7</sup>
THGS (kgf)	89.4 (20.3)	104.5 (12.1)	71.0 (10.1)	< 10 <sup>-6</sup>

Caption: BMI: body mass index; RHGS: right handgrip strength; LHGS: left handgrip strength; THGS: sum of handgrip strength.

<sup>#</sup>Statistically significant difference between men and women.

#### IV. Discussion

In a study with high-performance karate athletes, Rossi (2021) assessed body composition based on bioimpedance and noticed some expected differences in variables related to anthropometrics and body composition between sexes, due to the known sexual dimorphism pattern; accordingly, male athletes had higher values of all variables, except fat percentage and fat mass.

Fat percentage was, on average, 22.0 (6.8)% for the studied sample: 20.0 (8.0)% for men and 24.3 (4.4)% for women. Chabène and collaborators (2012), in a review on anthropometric characteristics and body composition of elite male karate athletes, reported minimum and maximum values of 7.5 (1.6)% (athletes from Japan) and 16.8 (2.51)% (athletes from Poland), respectively. Those authors highlighted that diverse factors can interfere in the results, including the chosen evaluation method and the athletes' experience degree, competitive level, age and physical conditioning. However, they also stated that there is no determining relationship between body fat and performance outcome. For women, there are only two studies, which reported fat percentages of 18.6 (2.51) (athletes from Botswana) (Amusa et al, 2001) and 21.0 (3.6) (athletes from Brazil) (Rossi, 2021).

In comparison, the athletes of the present study had higher fat percentage, considering both sexes; this could be explained since the data were collected after more than 2 years without in-person official competitions. During the pandemics, to prevent the propagation of contamination by the new Coronavirus, there were specific guidelines for the population to stay home; thus, most athletes could not have access to the training facilities. In addition, official competitions were cancelled, which had an even greater impact on the athletes' eating habits, training routine and physical conditioning, resulting in increased body mass, probably due to fat gain (Herrera-Valenzuela et al, 2020). This could justify the present findings of higher fat percentage and body mass index, especially for male athletes, compared to pre-pandemic studies with karate athletes.

Similarly to karate, combat sports (boxing, mixed martial arts and wrestling) have multifaceted success, which requires remarkable technical, tactical, physical and psychological skills for competition on any level and, therefore, cannot be predicted based on only one performance parameter. Studies have indicated moderate to strong correlation between HGS and sportive success in wrestling ( $r=0.41$ ) (Nikooie et al, 2017) and boxing ( $r=0.87$ ) (Guidetti et al, 2002). Moreover, HGS shows good capability to predict performance in combat sports when elite and sub-elite male athletes are compared; such differences are even more pronounced for female athletes. Thus, elite combat sports athletes also tend to have greater general strength (bench press, squat and barbell strength) and ballistic skills (vertical jumping, horizontal jumping, sprint and shot put performance), more strongly supporting the idea that HGS is a covariable of general strength (Cronin et al, 2016).

Iermakov and collaborators (2016) evaluated HGS, right and left, in 28 male martial arts athletes, who were allocated to two groups. For Group 1: athletes specialized in opponent's body immobilization, throws and grips (Greco-Roman and free wrestling, judo and sambo), right and left HGS were  $46.55\pm 4.39$  and  $43.82\pm 3.80$ , respectively, while for Group 2: athletes specialized in hitting, striking and hand-to-hand combat (karate and taekwondo), right and left HGS were  $35.59\pm 2.96$  and  $33.53\pm 2.77$ , respectively. Mean HGS values collected in the present study for karate athletes during the championship were 46.4 (10.2) kgf and 43.1 (10.4) kgf for the right and the left hand, respectively. Such values are more similar to those obtained for Group 1 athletes (Greco-Roman and free wrestling, judo and sambo), who use the hands, fingers and articulations to gain mechanical fight advantage over opponents, rather than to the values found for Group 2, which includes karate athletes. Paim et al (2012), in a transversal study with 15 high-level Shotokan karate athletes, obtained median right and left HGS of 47.8 kgf for men, and median right and left HGS of 27.6 kgf and 27.3 kgf, respectively, for women; such values were inferior to those found here.

The current results indicated that right and left HGS values, either alone or summed up, are significantly higher for male than for female athletes. According to Moura (2008), HGS peaks within the age range 25–35 years (mean age range of the athletes studied here) and is significantly higher for men than for women, considering all ages and both body sides; the dominant side is stronger for both sexes. Based on the present findings, such differences between sexes persist for competitive and ranked Shotokan karate athletes.

## V. Conclusion

The present study had as major characteristic the originality of collecting data during the first in-person national Shotokan karate championship of JKA-Brazil after Covid-19 pandemics. This study is also highlighted for including in the vast majority of its sample athletes that received an award during the championship and for having comparatively recorded body profile and handgrip strength of high-performance Shotokan karate athletes for the first time.

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