Anthropometric profile of the Brazilian male judo team: cross-sectional study

Perfil antropométrico de la selección brasileña masculina de judo: estudio transversal

Authors

André Luíz Lopes [1]
Gustavo dos Santos Ribeiro [2]
Bruno Costa Teixeira [3]
Randhall Bruce Carteri [1]
Paulo Cavalcante Muzy [4]
André Pontes-Silva [5]

[1] Universidade Federal do Rio Grande do Sul (Brasil)
[2] Universidade Federal de Ciências da Saúde de Porto Alegre (Brasil)
[3] Universidade do Estado de Minas Gerais (Brasil)
[4] Clínica Muzy (Brasil)
[5] Universidade Federal de São Carlos (Brasil)

Corresponding author:
André Pontes-Silva
contato.andrepsilva@gmail.com

How to cite in APA

Lopes, A. L., Ribeiro, G. dos S., Teixeira, B. C., Carteri, R. B., Muzy, P. C., & Pontes-Silva, A. (2025). Perfil antropométrico de la selección brasileña masculina de judo: estudio transversal. *Retos*, *64*, 44–54. https://doi.org/10.47197/retos.v64.110475

Abstract

Objective: To describe the anthropometric profile of the Brazilian judo team and compare it with physically active individuals.
Methods: Cross-sectional study. The sample consisted of eight high-performance athletes from a male judo team. This sample included judokas from four categories: extra-lightweight, middle-lightweight, light-weight, and middle-heavyweight. All athletes had experience in international tournaments and had won Pan-American, World, and Olympic medals. Data were analyzed with GraphPad Prism 5.01. Anthropometric indices, body composition and somatotype were analyzed by Mann-Whitney test with 95% confidence (significant p<0.05). Cohen's d effect size was used to determine the effect size between variables that were significantly different. Data are presented as median, minimum and maximum values (descriptive variables) or phantom z-scores (proportionality).
Results: The data indicate a very large effect size for the bone-muscle index (d = 2.72) and the mesomorphic phenotype (d = 1.33) in judokas and students. Large effect sizes were observed for muscle mass (d = 1.12), fat mass (d = -0.91), and the ectomorphic phenotype (d = -0.88). Moderate between-group effect sizes were observed for skinfolds (d = -0.71) and arm muscle area (d = 0.63).
Conclusions: Our study provides important information for the development of sport and athletes.

Keywords

Anthropometry; body composition; exercise; sport.

Resumen

Objetivo: Describir el perfil antropométrico del equipo brasileño de judo y compararlo con individuos físicamente activos.
Métodos: Estudio transversal. La muestra estuvo compuesta por ocho deportistas de alto rendimiento de un equipo de judo masculino. En esta muestra, había judokas de cuatro categorías: extraligero, medio-ligero, ligero y medio-pesado. Todos los atletas tenían experiencia en torneos internacionales y habían ganado medallas panamericanas, mundiales y olímpicas. Los datos se analizaron utilizando GraphPad Prism 5.01. Los índices antropométricos, composición corporal y somatotipo fueron analizados mediante la prueba de Mann-Whitney con un 95% de confianza (p<0,05 significativo). Se utilizó el tamaño del efecto d de Cohen para determinar el tamaño del efecto entre variables que eran significativamente diferentes. Los datos se presentan como mediana, valores mínimos y máximos (variables descriptivas) o puntuaciones z fantasma (proporcionalidad).
Resultados: Los datos indican un tamaño del efecto muy grande para el índice hueso-músculo (d = 2,72) y el fenotipo mesomórfico (d = 1,33) en judokas y estudiantes. Se observaron grandes tamaños del efecto para la masa muscular (d = 1,12), la masa grasa (d = -0,91) y el fenotipo ectomorfo (d = -0,88). Se observó un tamaño del efecto moderado para los pliegues cutáneos (d = -0,71) y el área de los músculos del brazo (d = 0,63) en todos los grupos.
Conclusiones: Nuestro estudio aporta información importante para el desarrollo del deporte y de los deportistas.

Palabras clave

Antropometría; composición corporal; deporte; ejercicio.

Introduction

The knowledge of biomechanical aspects that favor the performance of athletes is extremely relevant in high-performance sports (Bartlett, 2007; Morrien, Taylor, & Hettinga, 2017). The development of materials that enhance physical performance has been widely studied in sports science. Clothing that facilitates laminar flow for swimmers (Marinho et al., 2012), sneakers that improve ground reaction force in track and field (Lam et al., 2017), and prostheses that improve movement efficiency (Willwacher et al., 2017) are some examples of how biomechanics is used in sport.

However, it is not just external factors that can improve an athlete's performance. The human body is composed of a complex system of articulated segments that are closely linked to force production. Although physiological factors such as oxygen uptake, metabolic threshold and neural adaptations have a strong influence on athletic performance, the literature remains to be best explored with regard to the biomechanical advantage of the athlete's anthropometric profile.

The anthropometric profile of elite athletes is of great scientific importance, especially in the context of sports performance and athlete health. The medical literature highlights several reasons for this importance. First, body composition and anthropometric characteristics are fundamental to optimizing performance in various sports. For example, endurance athletes with greater fat mass tend to have longer running times, while greater lean mass benefits strength and power tasks (Silva, 2019). Furthermore, the somatotype profile, which includes components such as endomorphism, mesomorphism, and ectomorphism, is associated with the metabolic and biomechanical efficiency of athletes and directly influences sport performance (Baranauskas et al., 2024).

Studies also show that specific anthropometric characteristics can be predictors of success in certain sports. For example, in traditional rowing, stature and muscle mass are strongly correlated with performance, and in African long-distance runners, the anthropometric profile has a significant relationship with athletic performance in various sports, as shown by several studies in the literature (Baranauskas et al., 2024).

Anthropometric characteristics such as body mass, stature, body mass index and body composition are often associated with performance in specific sports. For example, in endurance sports such as running, athletes with lower body mass and lower body mass index tend to perform better, while in strength and power modalities such as sprinting, higher lean mass is beneficial (Silva, 2019; Sedeaud et al, 2014). In the context of cycling, it has been observed that cyclists with different anthropometric profiles specialize in specific cycling modalities, with mesomorphic cyclists performing better in sprints and ectomorphic cyclists performing better in fatigue tolerance tests (Van der Zwaard et al, 2019).

In addition, somatotype also influences motor performance. Somatotype, which classifies individuals into endomorphs, mesomorphs, and ectomorphs, is a predictor of performance, with mesomorphs generally performing better in strength and rapid force activities, whereas ectomorphs excel in flexibility and fatigue tolerance. These findings highlight the importance of considering the anthropometric profile when assessing and optimizing athletic performance in different sports (Cinarli et al., 2022; Terzi & Kalkavan 2024).

Scaling of bone dimensions and muscle moment arms is another critical issue. For example, peak muscle moment arms, which are influenced by bone dimensions, play a role in mechanical advantage and movement efficiency. This relationship is evident in the scaling of moment arms with bone dimensions in the upper extremity, which affects the mechanical leverage of muscles (Murray et al., 2002).

Allometry of muscle and bone, which refers to the growth of body parts at different rates, also plays a role. For example, muscle volume has been shown to scale with body mass and stature, and this scaling affects how muscles and bones interact to produce movement. The relationship between muscle volume and bone volume suggests that as muscle size increases, bone size may also adapt to meet increased mechanical demands (Handsfield et al., 2014).

In weightlifting, limb length and body composition are critical to performance, suggesting that the efficiency of the lever system is influenced by these factors. Longer limbs may provide a mechanical advantage in certain lifts, while muscle mass contributes to the generation of force required for lifting (Vidal et al, 2021). The interaction between muscle mass and bone mass is well documented. Muscle forces exerted on bone can lead to adaptations in bone structure, as seen in studies of athletes such as tennis players, where muscle-bone asymmetries are observed due to repetitive loading. This suggests that muscle volume and the forces it generates can influence bone diameter and length through adaptive responses (Ireland et al, 2013).

Judo is an Olympic sport in which the athlete must project the opponent backwards on the ground or control the ground fight in order to score an ippon (Drid et al., 2015; Franchini et al., 2011; Franchini, Sterkowicz-Przybycien, & Takito, 2014). For a judoka to defeat his opponent, his technique must be executed with extreme force and speed (Buśko, Pastuszak, & Kalka, 2017; Drid et al., 2015; Katralli & Goudar, 2012), factors that are influenced by the lever system of the human body (bone diameter, length, muscle volume, etc.).

Knowledge of these variables can provide coaches with a broad vision to develop training and competition strategies. Considering the above, this study aims to describe the anthropometric profile of the Brazilian judo team, and compare it with physically active individuals.

Methods

Experimental Approach to the Problem

In this cross-sectional study, the anthropometric profile of the Brazilian elite male judo team and college students paired by sex and age was evaluated. This research was approved by the local ethics committee of the Universidade Luterana do Brasil (report 2.876.188) according to the Declaration of Helsinki. All participants understood the procedures and signed the informed consent form. This research was conducted in accordance with the club periodization.

Participants

The sample consisted of eight elite athletes from a men's judo team. The sample included judokas from four categories: extra-lightweight (n = 2), middle-lightweight (n = 1), lightweight (n = 3), and middle-heavyweight (n = 2). All athletes had international competition experience and had won Pan-American, World, and Olympic medals. All assessments were conducted in January 2018. In addition, 45 paired male college students were evaluated to form the control group. Table 1 shows the anthropometric profile of the judokas and students.

Anthropometric Variables

All measurements were performed according to the recommendations of the International Society for Advanced Kinanthropometry (ISAK) and included 12 girths (head, neck, arm relaxed, arm flexed and tensed, forearm, chest, waist, abdomen, gluteal, thigh, medial thigh, and calf), nine lengths and heights (upper arm, forearm, hand, thigh, iliospinal height, trochanteric height, tibial height, and foot), six widths (bi-acromial, bi-iliocristal, transverse chest, anterior-posterior chest depth, humerus, and femur), and eight skinfolds (triceps, subscapular, biceps, iliac crest, supra-spinal, abdominal, femur, and medial calf). Four basic measures were also measured (body mass, stature, sitting height, and wingspan) (Stewart, Marfell-Jones, Olds, & De Ridder, 2011).

All measurements were taken between 9:00 and 10:00 am before the exercise session. A scientific skinfold caliper (Premier model), a segmometer, a large sliding caliper, and a small sliding caliper (Innovare 16 cm) were used to measure skinfolds, lengths, and widths, respectively. All of the above devices were manufactured by Cescorf (Porto Alegre, Brazil). Girths were measured using an anthropometric tape (Sanny, São Paulo, Brazil), and a mechanical scale with a coupled stadiometer (model 104A, Welmy, São Paulo, Brazil) was used to measure body mass and stature. Wingspan and sitting height were evaluated with anthropometric tape attached to the wall. The anthropometric box was used to facilitate the measurements.

Anthropometric Indexes

Equation proposed by Frisancho (1981) was used to determine arm muscle area. In addition, thigh muscle area was estimated using femur diameter, girth, and thigh skinfold data (Knapik, Staab, & Harman, 1996). The sum of peripheral (triceps, biceps, anterior thigh, and medial calf) and central (subscapular, iliac, supraspinale, and abdominal) skinfolds was also calculated. The bone-muscle index was evaluated by dividing muscle mass by bone mass (Fragoso et al., 2018). All indices were calculated in a specific software (Physical 5 Body composition analysis, Institute ISulBra, Porto Alegre, RS, Brazil).

Body Composition

The five-component anatomical tissue analysis model was applied to predict fat, bone, muscle, remnant, and skin mass (Ross & Kerr, 1991). Each component was calculated using the proportionality model as previously described (Ribeiro & Lopes, 2017). The Physical 5 body composition analysis software (Instituto ISulBra, Porto Alegre, RS, Brasil) was used to calculate each mass and generate proportionality scores.

Somatotype

Endomorphic, mesomorphic, and ectomorphic phenotypes were estimated using the anthropometric method with the three-dimensional approach (Carter et al., 1983). Ten anthropometric measurements were taken to calculate each aspect of somatotype: stature, body mass, four skinfolds (tricipital, subscapular, iliac, and medial calf), two circumferences (contracted arm and calf), and two widths (humerus and femur). The Heath-Carter somatochart was made in a specific software (Physical 5 Body Composition Analysis, Institute ISulBra, RS, Brazil).

Statistical Analyses

Data were analyzed using GraphPad Prism 5.01 (GraphPad Inc., San Diego, CA, USA). Anthropometric indices, body composition, and somatotype were analyzed using the Mann-Whitney test with 95% confidence (significant $p<0.05$). Cohen's d effect size was used to determine the effect size between variables that were significantly different. Data are presented as median, minimum and maximum values (descriptive variables) or phantom Z-scores (proportionality).

Results

Table 1 shows the anthropometric profile of the sample. The data show a very large effect size for the bone-muscle index (d = 2.72) and the mesomorph phenotype (d = 1.33) in judokas and students. A large effect size was observed for muscle mass (d = 1.12), fat mass (d = -0.91), and ectomorph phenotype (d = -0.88). A moderate effect size was observed for skinfolds (d = -0.71) and arm muscle area (d = 0.63) across groups.

Figure 1 shows the phantom proportionality scores between Brazilian judokas and male students. Variables in the gray area do not show significant differences (zone of normality). Data above the dotted line can be considered qualitatively larger in the judoka sample. It's observed an expressive muscle mass (z = 3.1 ± 0.5) among athletes, as well as arm circumference (z = 2.9 ± 0.8), forearm circumference (z = 2.9 ± 0.9), and arm muscle area (z = 2.7 ± 0.5), beyond the reduced skinfold sum (z = -3.7 ± 0.8).

In addition, other variables that did not appear to be significant in Figure 1 also proved to be different. Humeral width (7.5 ± 0.6 vs. 7.1 ± 0.4 cm; p = 0.043; z = 2.06 ± 0.85; d = 1.05), hand length (20.8 ± 2.0 vs. 19.2 ± 0.8 cm; p = 0.029; z = 1. 7 ± 1.3; d = 1.62), and biiliocristal width (26.3 ± 2.3 vs. 28.4 ± 2.7 cm; p = 0.033; z = -1.83 ± 0.81; d = -0.77) differed between samples.

Figure 2 shows the somatochart of Brazilian male judokas stratified by weight categories and male students. It can be observed that there is an increase in the mesomorphic and endomorphic phenotypes as the weight categories increase.

Table 1. Anthropometric measures of the sample.

Variables	Judo team (n=8)	Male students (n=45)	p-value
Basic variables			
Age (years)	24.5 (19.0 – 32.0)	24.0 (19.0 – 40.0)	0.991
Stature (cm)	173.5 (164.5 – 187.0)	176.5 (161.0 – 190.4)	0.556
Body mass (kg)	77.3 (63 – 108.0)	75.1 (58.0 – 98.9)	0.673

Anthropometric indexes			
Arm muscle area (cm)	31.5 (27.1 – 36.9)	29.0 (22.7 – 38.4)	0.042*
Thigh muscle area (cm^2)	1684 (1302 – 2013)	1533 (1156 – 2084)	0.274
Σ8SKF (mm)	74.7 (57.1 – 117.9)	107.2 (48.9 – 240.9)	0.019*
Central Σ4SKF (mm)	45.1 (36.8 – 65.9)	60.3 (27.9 – 167.0)	0.059
Peripheral Σ4SKF (mm)	27.9 (20.0 – 52.0)	39.1 (20.9 – 94.1)	0.005*
Bone muscle index	4.96 (4.44 – 5.33)	3.50 (2.50 – 5.00)	<0.001*
Body composition			
Muscle mass (kg)	40.5 (33.4 – 56.5)	30.9 (23.2 – 46.1)	<0.001*
Adipose mass (kg)	15.8 (12.2 – 25.1)	21.1 (14.0 – 54.9)	0.019*
Bone mass (kg)	8.7 (6.9 – 10.7)	9.1 (6.7 – 11.1)	0.494
Residual mass (kg)	8.5 (6.2 – 11.5)	8.5 (5.9 – 11.1)	1.000
Skin mass (kg)	3.8 (3.3 – 4.9)	3.9 (2.8 – 4.5)	0.841
Somatotype			
Endomorph	3.1 (2.1 – 3.9)	3.9 (1.5 – 8.7)	0.051
Mesomorph	7.0 (5.9 – 8.6)	5.9 (3.3 – 8.9)	0.003*
Ectomorph	1.2 (0.5 – 1.7)	2.1 (0.1 – 4.4)	0.031*

Σ8SKF, sum of eight skinfolds. Σ4SKF, sum of four skinfolds. Values expressed in median (minimum-maximum). *Significant differences (Mann-Whitney test).

Figure 1. Anthropometric proportionality of the male Brazilian judokas (●) and male students (○). AP: anterior-posterior; Σ8SKF: sum of eight skinfolds.

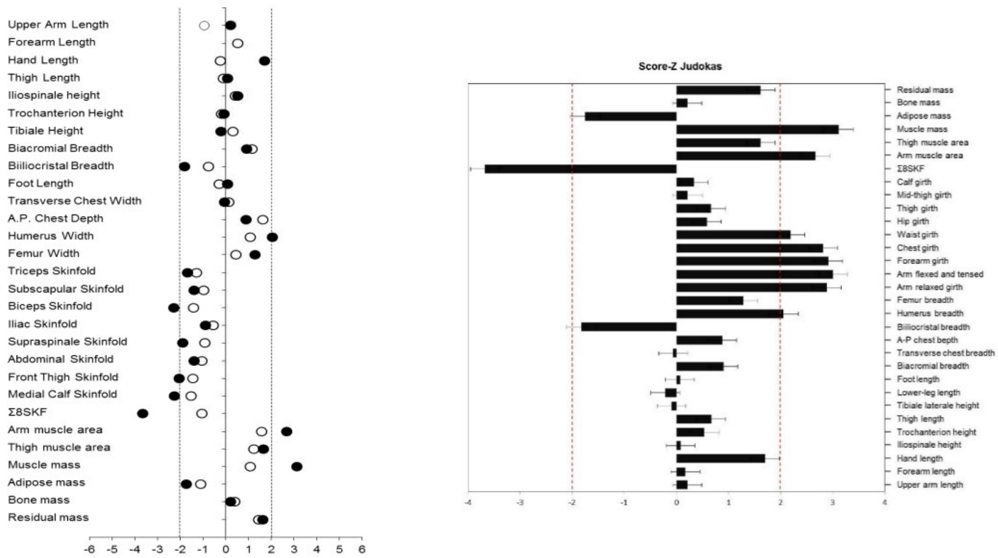
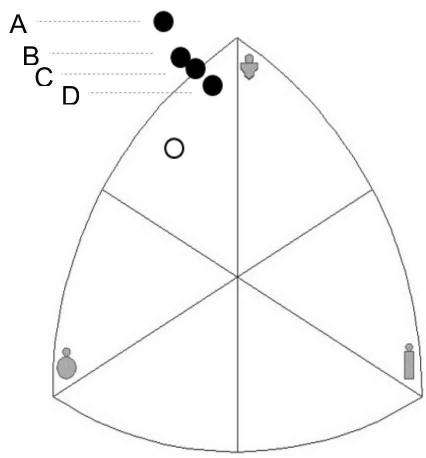


Figure 2. Somatotype of male Brazilian judokas (●) stratified by weight categories and male students (○). A, half-heavyweight (n=2). B, lightweight (n=3). C, half-lightweight (n=1). D, extra-lightweight (n=2).



Discussion

Our data suggest that elite judokas have a plastic component outside the normality curve. Significant values of muscle mass and arm muscle area were observed, admittedly factors associated with better performance (Casals et al., 2017; Drid et al., 2015). It was observed that biceps thickness and Σ8SKF were reduced, variables negatively associated with judo performance (Casals et al., 2017). Some anatomical components showed moderate values when standardized (hand length and hip and humeral width). An increase in both endomorphic and mesomorphic components was observed with increasing weight class.

Several studies have evaluated the anthropometric profile of judokas in an attempt to identify variables that could predict athletic success. Recently, Buśko et al. (2017) evaluated 15 Polish judokas and observed results similar to ours when compared to 154 active students. The authors observed that the 15 judokas had lower hip diameter and Σ6SKF, lower ectomorphism, and higher mesomorphism than their university counterparts. Unfortunately, Buśko et al. (2017) analyzed body composition using the two-component chemical model (Piechaczek, 1976), which prevents further comparisons. One interesting piece of information provided by Buśko et al. (2017) was the larger wrist diameter of the judokas.

Drid et al. (2015) analyzed the anthropometric profile of 10 Eastern European judo athletes, divided into elite (n = 5) and non-elite (n = 5). Although this study generated an immeasurable amount of data such as peak torque in four movements, palmar grip strength, dynamic strength, muscular endurance, aerobic capacity, anaerobic power, and specific judo performance, the anthropometric profile analysis was poor. Only five circumferences and four skinfolds were measured. Electrical bioimpedance was used to predict body fat, which prevented other comparisons. Nevertheless, it was clear that elite judokas had better anaerobic power, aerobic capacity, specific judo performance (30-second Tokui Waza test), and peak torque in shoulder rotation and knee extension.

Additionally, Franchini et al. (2011) studied the anthropometric profile of 87 Spanish judokas stratified by age: Cadets (<17 years), Juniors (<20 years), and Seniors (> 20 years). Of all the variables analyzed, two were worth mentioning: the diameter of the humerus and the circumference of the contracted arm. Cadets had lower values than the other age groups, suggesting a relationship between the diameter and the increase in muscle mass. In addition, the somatochart indicated a greater involvement of the mesomorphic component with advancing age. The authors concluded that the practice of judo, even at an early age, leads to an anthropometric profile specifically adapted to the demands of the sport.

In another study, Franchin et al. (2014) investigated the anthropometric profile of 104 Brazilian judokas of national and international level, divided into the categories of extra light, half-light, light, half-light, middle, half heavy and heavy. In line with our findings, this study observed an increase in the mesomorphic and endomorphic components with the advancement of the category, reinforcing the importance of weight gain in the heavy categories, independently if the gain is of muscle or fat mass. Although they have measured several anthropometric variables, the data are in absolute values. In this sense, it is natural that judokas in the heavier categories are taller and have higher measurements than their lighter counterparts, making other comparisons impossible.

Casals et al. (2017) investigated the association of anthropometric variables with judo performance (SJTF index) in 51 Spanish judokas (22 males and 29 females). Among the variables analyzed, biceps skinfold showed a negative association with the SJTF index, predicting up to 31% of the performance. In addition, the association of the ectomorph component with bone mass and muscle mass was able to predict 44% of the test results. It is important to note that the multiplicity of techniques used to predict body composition does not allow other conclusions to be drawn, since three different equations were used to create a new variable (De Rose, 1984; Rocha, 1975; Würch, 1974; Yuhasz, 1962). However, this detail does not detract from the excellence of the study. It is possible to conclude that athletes who are light (bone mass), strong (muscle) and tall (wingspan) have advantages in the performance of the SJFT index.

Previous studies compared athletes with healthy subjects (Buśko et al., 2017), elite and non-elite judokas (Drid et al., 2015), and of different weight categories (Franchini et al., 2014) and ages (Franchini et al., 2011). Katralli & Goudar (2012) fueled the discussion by confirming that long-term training had a minimal effect on the anthropometric profile of 31 Indian judokas, divided into two groups: ≤ 5 years and> 5 years. An interesting finding was the negative correlation (r = -0.690) of body fat with motor performance (number of projections in the SJFT). In addition, they mention that other studies also observed low body fat in Hungarian (8.9%), Canadian (12.3%), Japanese (16.2%), Brazilian (13.7%) and North American (8.3%) athletes.

However, the diversity of methods used to predict body composition in these studies precludes further comparisons. Prediction models (e.g., anatomical vs. chemical), measurement techniques (e.g., skinfolds vs. electrical bioimpedance), or equations applied (e.g., Piechaczek vs. Jackson) may yield conflicting results (Ackland et al., 2012; Franchini et al., 2011; Lopes & Ribeiro, 2014; Torres-Luque et al., 2016). In our study, the five-component anatomical model was used to estimate body composition. Another difference was the use of standardized measures (SCORE-Z) to analyze the anthropometric profile. This approach allows for correction of interpretation errors related to body size or sexual dimorphism when absolute values are used.

The most significant variables in our standardized analysis were muscle mass and Σ8SKF. Indeed, Franchini et al. (Franchini et al., 2014) cite that "*judo athletes usually try to maximize muscle mass and to minimize adiposity in each weight category to gain an advantage over weaker opponents*". Moreover, previous studies have reported that muscle mass is an independent predictor of anaerobic performance and better SJFT performance (Casals et al., 2017; Kim et al. 2011; Kubo et al., 2006). Furthermore, the higher arm muscle area observed in the standardized analysis has also been associated with better performance in judo competitions (Drid et al., 2015; Kubo et al., 2006). The reasons for this are clear: higher muscle mass equals greater muscle power, and lower fat mass favors maintenance in the weight class.

According to Sacripanti (2010), the elbow flexor musculature plays a crucial role in judo due to the need of judokas to control their opponents and unbalance them with pulls and/or throws. In fact, arm muscle area is positively associated with greater force production, especially in experienced athletes (Okano et al., 2008), and this can be crucial for a judoka to gain advantages over his opponent. Furthermore, if the largest muscle area and normal arm length are associated, a mechanical advantage will be obtained favoring to judokas' performance. In addition, a low biceps skinfold has been associated with good judo performance (Bala & Drid, 2010; Casals et al., 2017).

Moreover, other proportionality characteristics observed in Table 2 deserve to be highlighted. Variables outside the normality curve, after two SD (± 2.0), contribute more strongly to the anthropometric profile of athletes and are often decisive for sports performance. However, this does not mean that the other measures should be neglected. Variables between the first and second SD (1.0 to 2.0 and -1.0 to -2.0) also deserve attention, as their association with other measures can provide valuable information for sport.

For example, a large effect of hip width is observed. According to Detanico & Santos (2007), *Koshi-Waza* techniques are projections that use the hip as a support point of the lever system to cause the opponent's projection (uke). Although hip width has nothing to do with the judoka's center of gravity, a narrow hip facilitates the twisting of the entry point to make the throw, improving technique and mechanical advantage over the opponent. Brazilian judokas showed a moderate width (z = -1.83 ± 0.81), almost at the lower limit to discriminate outliers. In support of this finding, Melo et al. (2013) emphasize that hip displacement is crucial to improve the mechanical efficiency of throwing techniques (*Te-Waza* or *Koshi-Waza*).

Additionally, another variable seems to be involved in the performance of judokas: and hand length. Basically, there are three dominant types of Judo grips: cylindrical, round, and lifting (Sacripanti, 2010). Regardless of the type of grip, it is known that the maximum grip forces are applied with the minimum cylinder diameter, meaning that stronger grips require less amount of judogi to grip (Sacripanti, 2010). Therefore, a larger grip favors the production of power, an essential component of Kumi-kata.

Since we evaluated athletes of different weight categories, it is necessary to use the standardized measures, such as the height-adjusted phantom z-score, to evaluate their influence on the anthropometric profile of each judoka. It is important to emphasize that our paired sample was composed of university students of physical education, many ex-athletes or amateur athletes of different sports, which is a limitation of this study.

Practical Applications

The knowledge of the morphological and physiological profile of athletes, regardless of the sport, allows the entire team involved to extract information to improve, prevent and manage situations that each athlete may face during the season or career. Our study provides important information for the development of sports and athletes. Science must be close to practice so that together they can promote greater safety in the prescription and control of training. By characterizing an athlete in morphological terms, we can understand the characteristics that can help in combat.

The wingspan allows us to understand the anticipation of the footprint in the kimono, the leg length allows us to verify the distance from the center of gravity of the ground to identify strengths and weaknesses, in addition to refining or not scanning techniques. Thus, in addition to assisting in the preparation of training sessions, morphological characterization can, in a way, help in the elaboration of strategies of combat, which can be an important differential in national and international competitions.

Conclusions

The research showed the importance of variables such as arm muscle area and hip width, which contribute to mechanical advantages in throwing movements and body control in judo. Greater hand width is highlighted as facilitating a stronger and more effective grip on the kimono, which is essential for throwing techniques. In addition, the use of standardized measures, such as the height-adjusted z-score, allowed for a more accurate assessment of the influences of these characteristics on judokas, regardless of weight category, although the control sample composed of physical education students with previous sports experience is a limitation to be considered in our study. With the increasing need for more precise adjustments to achieve performance, we suggest that further studies with other professional judo athletes can be conducted and enrich the discussion on this topic.

Acknowledgements

N/A.

Financing

N/A.

References

Ackland, T. R., Lohman, T. G., Sundgot-Borgen, J., Maughan, R. J., Meyer, N. L., Stewart, A. D., & Muller, W. (2012). Current status of body composition assessment in sport: review and position statement on behalf of the ad hoc research working group on body composition health and performance, under the auspices of the I.O.C. Medical Commission. *Sports Med, 42*(3), 227-249. doi:10.2165/11597140-000000000-00000

Baranauskas, M., Kupčiūnaitė, I., Lieponienė, J., & Stukas R (2024). Dominant Somatotype Development in Relation to Body Composition and Dietary Macronutrient Intake among High-Performance Athletes in Water, Cycling and Combat Sports. Nutrients. 15;16(10):1493.

Bala, G., & Drid, P. (2010). Anthropometric and motor features of young judoists in Vojvodina. *Coll Antropol, 34*(4), 1347-1353.

Bartlett, R. (2007). *Introduction to Sports Biomechanics: analysing human movement patterns* (2nd ed.). New York: Taylor & Francis.

Buśko, K., Pastuszak, A., & Kalka, E. (2017). Body composition and somatotype of judo athletes and untrained male students as a reference group for comparison in sport. *Biomedical Human Kinetics, 9*(1), 7-13.

Carter, J. E. L., Ross, W. D., Duquet, W., & Aubry, S. P. (1983). Advances in somatotype methodology and analysis. *American Journal of Physical Anthropology, 26*(S1), 193-213. doi:10.1002/ajpa.1330260509

Casals, C., Huertas, J. R., Franchini, E., Sterkowicz-Przybycien, K., Sterkowicz, S., Gutierrez-Garcia, C., & Escobar-Molina, R. (2017). Special Judo Fitness Test Level and Anthropometric Profile of Elite Spanish Judo Athletes. *J Strength Cond Res, 31*(5), 1229-1235. doi:10.1519/jsc.0000000000001261

Cinarli, F.S., Buyukcelebi, H., Esen, O., Barasinska, M., Cepicka, L., Gabrys, T., Nalbant, U., & Karayigit R. (2022). Does Dominant Somatotype Differentiate Performance of Jumping and Sprinting Variables in Young Healthy Adults? Int J Environ Res Public Health. 19(19):11873.

De Rose, E. (1984). *Cineantropometria, educação física e treinamento desportivo*. Rio de Janeiro: MEC.

Detanico, D., & Santos, S. G. d. (2007). The relation between body proportionality of Judoka and his preference technique (tokui-waza). *R Bras Ci e Mov, 15*(3), 15-24.

Drid, P., Casals, C., Mekic, A., Radjo, I., Stojanovic, M., & Ostojic, S. M. (2015). Fitness and anthropometric profiles of international vs national Judo medalists in half-heavyweight category. *J Strength Cond Res, 29*(8), 2115-2121. doi:10.1519/jsc.0000000000000861

Fragoso, E., Zaccani, W., Guimarães, A., Ribeiro, G., Lima, A., Silva, R., . . . Lopes, A. (2018). *Muscle-bone index: a new paradigm for the monitoring of athletes performance* Paper presented at the Annals of the 35th FIMS World Congress of Sports Medicine Rio de Janeiro.

Franchini, E., Del Vecchio, F. B., Matsushigue, K. A., & Artioli, G. G. (2011). Physiological profiles of elite judo athletes. *Sports Med, 41*(2), 147-166. doi:10.2165/11538580-000000000-00000

Franchini, E., Huertas, J. R., Sterkowicz, S., Carratalá, V., Gutiérrez-García, C., & Escobar-Molina, R. (2011). Anthropometrical profile of elite Spanish Judoka: comparative analysis among ages. *Archives of Budo Science of Martial Arts and Extreme Sports, 7*(4), 239-245.

Franchini, E., Sterkowicz-Przybycien, K., & Takito, M. Y. (2014). Anthropometrical profile of judo athletes: comparative analysis between weight categories. *Int J Morphol, 32*(1), 36-42.

Frisancho, A. R. (1981). New norms of upper limb fat and muscle areas for assessment of nutritional status. *Am J Clin Nutr, 34*(11), 2540-2545.

Handsfield, G.G., Meyer, C.H., Hart, J.M., Abel, M.F., & Blemker, S.S. (2014). Relationships of 35 lower limb muscles to height and body mass quantified using MRI. J Biomech. 7;47(3):631-8. doi: 10.1016/j.jbiomech.2013.12.002.

Ireland, A., Maden-Wilkinson, T., McPhee, J., Cooke, K., Narici, M., Degens, H., & Rittweger, J. (2013). Upper limb muscle-bone asymmetries and bone adaptation in elite youth tennis players. Med Sci Sports Exerc. Sep;45(9):1749-58. doi: 10.1249/MSS.0b013e31828f882f.

Katralli, J., & Goudar, S. S. (2012). Anthropometric profile and special judo fitness levels of Indian Judo players. *Asian J Sports Med, 3*(2), 113-118.

Kim, J., Cho, H. C., Jung, H. S., & Yoon, J. D. (2011). Influence of performance level on anaerobic power and body composition in elite male judoists. *J Strength Cond Res, 25*(5), 1346-1354. doi:10.1519/JSC.0b013e3181d6d97c

Knapik, J. J., Staab, J. S., & Harman, E. A. (1996). Validity of an anthropometric estimate of thigh muscle cross-sectional area. *Med Sci Sports Exerc, 28*(12), 1523-1530.

Kubo, J., Chishaki, T., Nakamura, N., Muramatsu, T., Yamamoto, Y., Ito, M., . . . Kukidome, T. (2006). Differences in fat-free mass and muscle thicknesses at various sites according to performance level among judo athletes. *J Strength Cond Res, 20*(3), 654-657. doi:10.1519/r-17054.1

Lam, W.-K., Ryue, J., Lee, K.-K., Park, S.-K., Cheung, J. T.-M., & Ryu, J. (2017). Does shoe heel design influence ground reaction forces and knee moments during maximum lunges in elite and intermediate badminton players? *PLoS ONE, 12*(3), e0174604-e0174604. doi:10.1371/journal.pone.0174604

Lopes, A., & Ribeiro, G. (2014). *Antropometria aplicada à saúde e ao desempenho esportivo: uma abordagem a partir da metodologia ISAK*. Rio de Janeiro: Rúbio.

Marinho, D. A., Mantha, V. R., Vilas-Boas, J. P., Ramos, R. J., Machado, L., Rouboa, A. I., & Silva, A. J. (2012). Effect of wearing a swimsuit on hydrodynamic drag of swimmer. *Brazilian Archives of Biology and Technology, 55*, 851-856.

Melo, S. I. L., Santos, S. G. d., Piucco, T., & Teixeira, J. S. (2013). Influence of judoka height when using the seoi nage technique. *Revista Brasileira de Cineantropometria & Desempenho Humano, 15*, 578-586.

Morrien, F., Taylor, M. J. D., & Hettinga, F. J. (2017). Biomechanics in Paralympics: Implications for Performance. *Int J Sports Physiol Perform, 12*(5), 578-589. doi:10.1123/ijspp.2016-0199

Murray, W.M., Buchanan, T.S., & Delp, S.L. (2002). Scaling of peak moment arms of elbow muscles with upper extremity bone dimensions. J Biomech. Jan;35(1):19-26. doi: 10.1016/s0021-9290(01)00173-7..

Okano, A. H., Cyrino, E. S., Nakamura, F. Y., Guariglia, D. A., Nascimento, M. A., Avelar, A., & Moraes, A. C. (2008). Behavior of the muscle strength and arm muscle area during 24 weeks of weight training. *Brazilian Journal of Kinanthropometry and Human Performance; Vol 10, No 4 (2008)*. doi:10.5007/1980-0037.2008v10n4p379

Piechaczek, H. (1976). Estimation of total body fat by densitometric and anthropometric methods. *Stud Phys Anthropol, 2*, 33-45.

Ribeiro, G., & Lopes, A. (2017). Análise da composição corporal: evolução histórica do modelo anatômico de análise tecidual. *RBPFEX - Revista Brasileira de Prescrição e Fisiologia do Exercício; v. 11, n. 68 (2017)*.

Rocha, M. (1975). Peso osseo do brasileiro de ambos os sexos de 17 a 25 anos. *Arquivos de Anatomia e Antropologia, 1*, 445-451.

Ross, W. D., & Kerr, D. (1991). Fraccionamiento de la masa corporal: un nuevo método para utilizar en nutrición clínica y medicina deportiva. *Apunts Med Esport, 28*(109), 175-188.

Sacripanti, A. (2010). *Advances in Judo biomechanics research: modern evolution on ancient roots*. Monaco: VDM Publishing.

Sedeaud, A., Marc, A., Marck, A., Dor, F., Schipman, J., Dorsey, M., Haida, A., Berthelot, G., & Toussaint JF. (2014). BMI, a performance parameter for speed improvement. PLoS One. Feb 25;9(2):e90183. doi: 10.1371/journal.pone.0090183.

Silva, A.M. (2019). Structural and functional body components in athletic health and performance phenotypes. Eur J Clin Nutr. Feb;73(2):215-224. doi: 10.1038/s41430-018-0321-9.

Stewart, A., Marfell-Jones, M., Olds, T., & De Ridder, H. (2011). *International Standards for Anthropometric Assessment. A manual for teaching materials for accreditation* (3rd ed.). South Africa: ISAK.

Terzi, E., & Kalkavan, A. (2024). To what extent do somatotype structures affect athletic performance in professional athletes? J Sports Med Phys Fitness. Jul;64(7):650-660. doi: 10.23736/S0022-4707.24.15826-4.

Torres-Luque, G., Hernández-García, R., Escobar-Molina, R., Garatachea, N., & Nikolaidis, P. T. (2016). Physical and Physiological Characteristics of Judo Athletes: An Update. *Sports (Basel, Switzerland), 4*(1), 20. doi:10.3390/sports4010020

Van der Zwaard, S., de Ruiter, C.J., Jaspers, R.T., & de Koning, J.J. (2019). Anthropometric Clusters of Competitive Cyclists and Their Sprint and Endurance Performance. Front Physiol. Oct 9;10:1276. doi: 10.3389/fphys.2019.01276..

Vidal Pérez, D., Martínez-Sanz, J.M., Ferriz-Valero, A., Gómez-Vicente, V., & Ausó E. (2021). Relationship of Limb Lengths and Body Composition to Lifting in Weightlifting. Int J Environ Res Public Health. Jan 17;18(2):756. doi: 10.3390/ijerph18020756.

Willwacher, S., Funken, J., Heinrich, K., Müller, R., Hobara, H., Grabowski, A. M., . . . Potthast, W. (2017). Elite long jumpers with below the knee prostheses approach the board slower, but take-off more effectively than non-amputee athletes. *Sci Rep, 7*(1), 16058-16058. doi:10.1038/s41598-017-16383-5

Würch, A. (1974). La femme et le sport. *Med Sport Francaise, 4*(1), 441-445.

Yuhasz, M. (1962). *The effects of sports training on body fat in man with predictions of optimal body weight.* (Phylosophy in Physical Education in the Graduate College of the University of Illinois Doctoral), University of Illinois, Illinois.

Authors' and translators' details:

André Luíz Lopes	andregym23@gmail.com	Author
Gustavo dos Santos Ribeiro	gustavopoa84@hotmail.com	Author
Randhall Bruce Carteri	rcarteri@outlook.com	Author
Paulo Cavalcante Muzy	paulo@clinicamuzy.com.br	Author
André Pontes-Silva	contato.andrepsilva@gmail.com	Author & Translator