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Body composition and handgrip strength in Brazilian Jiu-Jitsu athletes: a systematic review

Composición corporal y fuerza prensil en Jiu-Jitsu Brasileño: una revisión sistemática

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Abstract

Objectives: *This study aimed to review the evidence available regarding body composition and maximal isometric handgrip strength values and establish average values and relationships between these variables in Brazilian Jiu-Jitsu athletes.* **Methods:** *MEDLINE through PubMed; base plate; Web of Science; Scopus; Pedro; CDSR; CCRCT; LILACS; Educational Resources; EBSCO; and ADOLEC databases were explored to identify articles that met selection criteria. Observational or comparative studies evaluating the body composition and maximal isometric handgrip strength of BJJ athletes through dynamometry.* **Results:** *Only ten papers (n = 394 athletes) met selection criteria. The methodological quality of the studies assessed with the Newcastle–Ottawa Scale was rated fair to good, and the methodological quality of the studies assessed with the appraisal tool for cross-sectional studies was rated low to moderate. The population studied was predominantly male (n = 364), with two studies including females (n = 30). Two reported maximal isometric handgrip strength, four reported right- or left-hand grip strength, and five reported handgrip strength differentiating between dominant and non-dominant hands. All selected studies reported weight, height, and body fat percentages, six reported body mass index, three reported fat-free mass or muscle mass percentages, and two reported lean body mass or somatotype.* **Conclusions:** *We could not establish average values or relationships between the variables studied due to lack of concordance in the reporting of these variables in the studies reviewed. It is necessary to standardize the variables reported in studies regarding this sport to establish comparisons between scientific evidence.*

Keywords: *Hand strength. Anthropometry. Somatotypes. Martial arts. Sports. Sports medicine.*

Resumen

Objetivos: *revisar la evidencia disponible sobre composición corporal y fuerza prensil en atletas de Jiu-Jitsu brasileño y establecer valores promedio y relaciones entre estas variables.* **Métodos:** *MEDLINE vía PubMed; base plate; Web of Science; Scopus; Pedro; CDSR; CCRCT; LILACS; Se exploraron las bases de datos EBSCO y ADOLEC para identificar artículos que cumplieran con los criterios de selección.* **Resultados:** *Solo diez estudios (n = 394 atletas) cumplieron con los criterios de*

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selección. La calidad metodológica de los estudios evaluados con la escala de Newcastle–Ottawa se calificó de regular a buena, y la calidad metodológica con la herramienta de evaluación para estudios transversales se calificó de baja a moderada. La población estudiada fue predominantemente masculina (n = 364), con dos estudios que incluyeron mujeres (n = 30). Dos estudios informaron la fuerza prensil isométrica máxima, cuatro informaron la fuerza prensil de mano derecha o izquierda y cinco la diferenciación entre manos dominantes y no dominantes. Todos los estudios seleccionados informaron el peso, la altura y los porcentajes de grasa corporal, seis el índice de masa corporal, tres los porcentajes de masa libre de grasa o masa muscular y dos la masa corporal magra o el somatotipo. **Conclusión:** *No fue posible establecer valores promedio de las variables de interés o relaciones entre las mismas debido a falta de concordancia en el reporte de estas variables en los estudios revisados. Es necesario estandarizar las variables reportadas en los estudios sobre este deporte para establecer comparaciones.*

Palabras clave: *Fuerza prensil. Antropometría. Somatotipos. Artes marciales. Deportes. Medicina del deporte.*

Introduction

Brazilian Jiu-jitsu (BJJ) is a grappling-based combat sport in which athletes immobilize and apply joint locks (wrist, elbow, knee, and ankle locks), strangulation, and pressure techniques[1,2], where handgrip strength is crucial. Handgrip strength is the resulting act of flexing all the phalangeal joints, including the thumb, to stabilize an object being gripped with the fingers and the palm[3]. In combat sports, handgrip strength is vital for grappling sports performers (Judo, Olympic or Greco-Roman Wrestling, Aikido, BJJ, and others) who grip their opponent's body parts or the uniform to obtain dominant positions, strangulations, and joint locks. Handgrip strength is affected by the integrated performance of hand and forearm muscles in a muscle contraction. Strength is quantified by measuring the static force that the hand generates by gripping a dynamometer. Several dynamometers (hydraulic or electronic) measure handgrip strength with different normative values and populations. Hydraulic dynamometers, like the Jamar dynamometer, are commonly used[4]. Average handgrip strength values are based on age, gender, and hand dominance for different populations with different reference methods[3]. However, well-defined reference data does not exist for grappling sports practitioners.

Anthropometry is a simple, trustworthy, and inexpensive method for evaluating an individual's nutritional state, proportions, size, and body composition[5]. Anthropometric measures help quantify total body fat, regional body fat, lean mass, and other clinically significant medical, nutritional, and sports-related data[5].

This review aimed to determine the average body composition and maximal isometric handgrip strength values found in BJJ athletes. The specific objectives of the study were to determine BJJ athletes' most common anthropometric and body composition characteristics, to determine the most common somatotype in BJJ athletes, and to determine if there is a relationship between these variables.

Methods

Eligibility criteria

This study was observational, comparative, and cross-sectional studies evaluating the body composition and the maximal isometric handgrip strength in BJJ athletes through dynamometry. Studies evaluating BJJ athletes' somatotype were also considered. Articles were excluded if they met the following criteria: they were evaluating athletes from grappling sports other than BJJ, athletes under 18 years of age, and studies that did not include data regarding the two main variables (body composition and maximal isometric handgrip strength). Other systematic reviews or meta-analyses were excluded from the study.

Information sources

A literature search was conducted by an experienced librarian on March 01, 2022, in the following databases: MEDLINE through PubMed; Embase, Web of Science, Scopus, PEDro, CDSR, CCRCT, LILACS, Educational Resources, Academic Research Premier (EBSCO), and the Virtual Bibliography on Adolescent Health (ADOLEC). The search strategies included terms related to the exposure and outcome variables, including the following MeSH terms: body composition, densitometry, electric impedance, tomography, radioisotope dilution technique, somatotypes, and jiu-jitsu. Terms were adopted according to MEDLINE guidelines with no language restrictions. Date ranges for the search varied in each database: EBM Reviews – Cochrane Central Register of Controlled Trials <November 2021>; EBM Reviews – Cochrane Database of Systematic Reviews <2005 to December 28, 2021>;

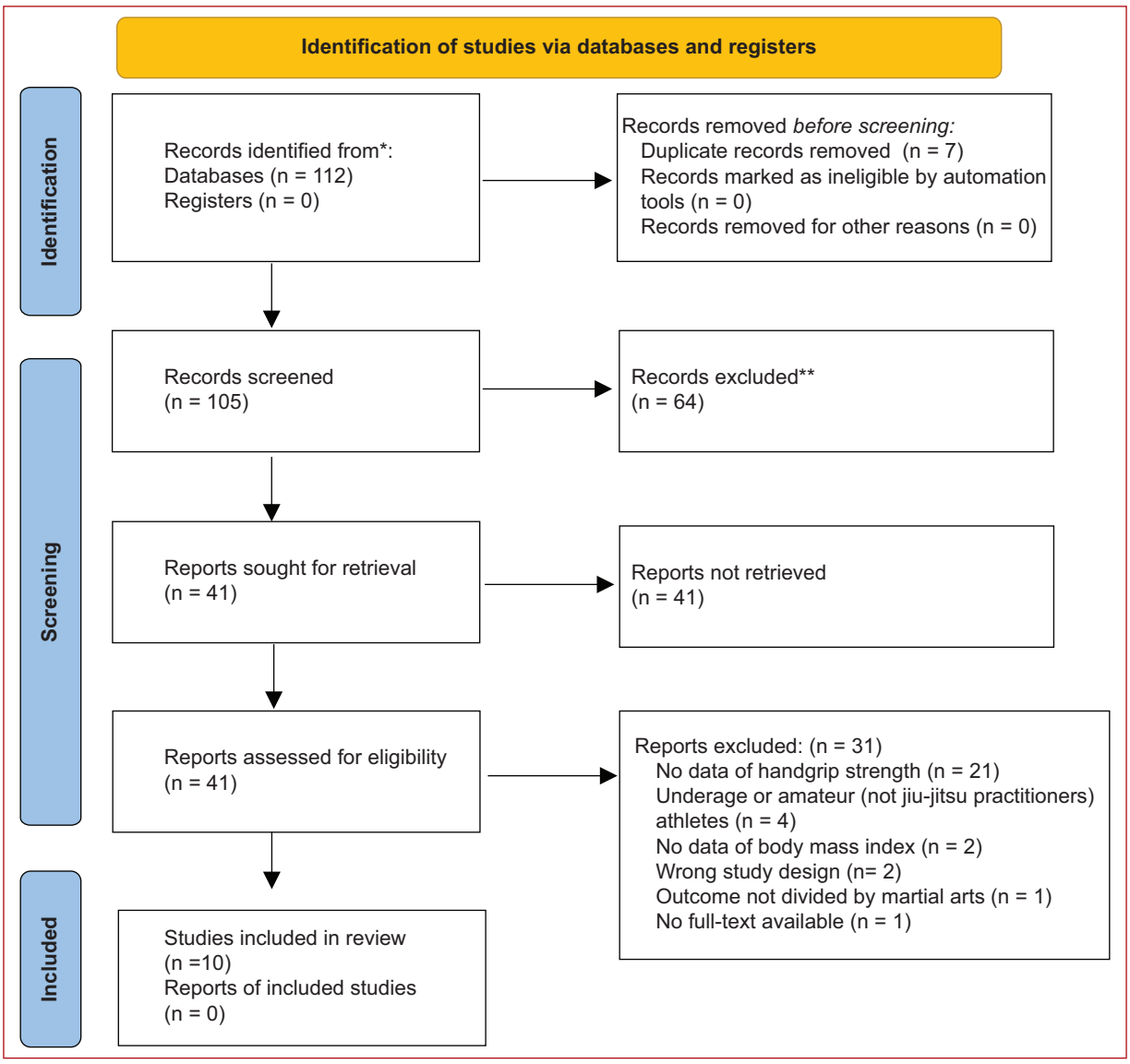

Figure 1. Study selection flowchart (PRISMA 2020)[9].
*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers). **If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools. From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org

Embase <1974 to 2021 December 30>; and Ovid MEDLINE(R) ALL <1946 to December 30, 2021>

This systematic review was registered in PROSPERO with ID CRD42022311799.

This systematic review adheres to the standards set in the Meta-Analysis of Observational Studies in Epidemiology (MOOSE), and the Preferred Reported Items for Systematic Reviews and Meta-Analysis (PRISMA 2020)[6]. The methodological quality of each study was assessed using the Newcastle–Ottawa Scale (NOS)[7] and the Appraisal tool for Cross-Sectional Studies (AXIS)[8]. Data were extracted independently and in duplicate for all variables. Conflicts between reviewers were resolved by consensus by a team of four reviewers. Data were assessed with the intent of conducting a meta-analysis.

Table 1. Characteristics of the studies reviewed

Author, year	Groups	n	Age, mean ± SD	Study design	Study quality
Burdukiewicz et al., 2020[16]	M	30	21.6 ± 2.6	Cross-sectional	Low (AXIS)
Detanico et al., 2021[14]	M	20	28.1 ± 7.1	Cross-sectional	Moderate (AXIS)
	F	23	23.6 ± 5.3	Cross-sectional	Moderate (AXIS)
Díaz-Lara et al., 2015[10]	M	26	28.9 ± 4.2	Cohort	Fair (NOS)
Díaz-Lara et al., 2014[11]	M (Beginners)	24	29.9 ± 5.8	Cohort	Good (NOS)
	M (Experts)	32	30.5 ± 4.7	Cohort	Good (NOS)
Pietraszewska et al., 2014[12]	M	49	23.4	Cohort	Good (NOS)
Schwartz et al., 2015[15]	M	136	28.0 ± 4.2	Cross-sectional	Moderate (AXIS)
Andreato et al., 2016[1]	M	15	28 ± 5.0	Cross-sectional	Low (AXIS)
Andreato et al., 2017[13]	M	10	29 ± 5.0	Cohort	Good (NOS)
Andreato et al., 2015[9]	M	10	28 ± 4	Cohort	Fair (NOS)
Rezende et al., 2019[17]	M	12	22.91 ± 6.4	Cross-sectional	Low (AXIS)
	F	7	21.28 ± 4.68	Cross-sectional	Low (AXIS)

SD: standard deviation, M: males, F: females, NOS: Newcastle–Ottawa Scale, AXIS: appraisal tool for cross-sectional studies.

Results

One hundred and twelve studies were obtained from all the databases, but only ten studies were selected for the data extraction and analysis phase (Figure 1). One article could not be obtained in full-text, the authors were contacted to obtain this study, but we received no response from the authors. The risk of bias and individual study quality of cohort studies was assessed with the NOS[7]. The research conducted by Andreato et al. in 2015[9] was rated as a fair-quality study. The rest of the studies were rated as good quality studies[10-13]. The risk of bias and individual study quality of cross-sectional studies was assessed with the AXIS[8]. The studies conducted by Detanico et al.[14] and Schwartz et al.[15] were rated as moderate-quality studies. The rest of the studies were rated as low-quality[1,16,17]. The risk of bias of individual studies had to be assessed with different tools due to the different types of studies included in this systematic review.

The population studied included male participants in all the selected studies. Only the studies by Detanico et al.[14] and Rezende et al.[17] included female participants. The research by Díaz-Lara et al.[10] included male athletes with distinct levels of expertise. Schwartz et al.[15] conducted the study with the most significant number of participants, 136 male participants (Table 1). The selected studies reported very heterogeneous variables concerning handgrip strength: two reported maximal isometric handgrip strength, four reported grip strength differentiating between the right and left hand, and five reported grip strength differentiating between dominant and non-dominant hands. Manual dominance was reported in only one study (Table 2).

In the data concerning body composition (Table 3), all selected studies reported weight and height, but six reported body mass index. All studies reported body fat percentages; three reported fat-free mass, and two reported lean body mass. Muscle mass percentage was reported in only three of the ten studies selected for this review. Only two of the ten selected studies reported data concerning somatotype (Table 4). Mean values of the variables assessed in this study could not be established.

Discussion

The maximal isometric handgrip strength values reported by Schwartz et al.[15] were far from average in terms of kgf reached by manual dynamometry, with values of 103 ± 17 kgf, which may have been due to an error in reporting the data measured in kgf instead of being reported as lbf (pound-force). The variability in data concerning grip strength made it difficult to analyze these variables among the studies selected for this review. The variability in the type of population studied and the lack of homogenization in the reported variables made it

Table 2. Handgrip strength

Author, Year	Groups	n	MIHS (kgf)	Right hand (kgf)	Left hand (kgf)	DOM (kgf)	N-DOM (kgf)	HD
Burdukiewicz et al., 2020[16]	M	30	NR	47.4 ± 9.55	46.6 ± 8.03	NR	NR	12% LH
Detanico et al., 2021[14]	M	20	NR	NR	NR	43.1 ± 7.13	42.3 ± 9.05	NR
	F	23	27.2 ± 4.94	NR	NR	27.2 ± 4.94	24.8 ± 4.82	NR
Díaz-Lara et al., 2015[10]	M	26	NR	NR	NR	50.8 ± 5.2	48.5 ± 5.6	NR
Díaz-Lara et al., 2014[11]	M Beginners	24	NR	43.6 ± 7.1	43.3 ± 6.6	NR	NR	NR
	M Experts	32	NR	48.6 ± 6.1	49.1 ± 7.0	NR	NR	NR
Pietraszewska et al., 2014[12]	M	49	NR	47.8 ± 8.31	46.2 ± 7.59	NR	NR	NR
Schwartz et al., 2015[15]	M	136	103 ± 17	NR	NR	NR	NR	NR
Andreato et al., 2016[1]	M	15	NR	NR	NR	53 ± 7	50 ± 9	NR
Andreato et al., 2017[13]	M	10	NR	NR	NR	49 ± 6	47 ± 6	NR
Andreato et al., 2015[9]	M	10	NR	NR	NR	53 ± 6	50 ± 9	NR
Rezende et al., 2019[17]	M	12	NR	47.35 ± 8.77	40.75 ± 8.45	NR	NR	NR
	F	7	NR	30.28 ± 6.65	25.57 ± 5.94	NR	NR	NR

SD: standard deviation, M: males, F: females, MIHS: maximal isometric handgrip strength, kgf: kilogram-force, DOM: dominant hand, N-DOM: non-dominant hand, HD: hand dominance, LH: left-handed, NR: not reported.

difficult to conduct an adequate comparative analysis between the ten selected studies to establish normative values. Only two of the ten selected studies reported data concerning somatotype. This fact made establishing common or normative values of endomorphy, mesomorphy, or ectomorphy in this population complex.

Some studies have analyzed BJJ athletes' anthropometric variables or morphologic/morphofunctional profiles; however, a relationship between these profiles and isometric handgrip strength has still not been found. These profiles have not been measured with other anthropometric variables[18,19]. A systematic review of BJJ-athletes' physical and physiological profiles[20] showed the results of 18 studies that measured maximal isometric handgrip strength. The authors found measurements from 48 to 57 kgf in elite BJJ athletes. Nevertheless, no relationship with anthropometric variables was searched. Andreato et al.[1] analyzed the physiological, nutritional, and performance profiles of 15 BJJ athletes (28 ± 5 years; eight brown belts and seven black belts, with a training experience of 11 ± 4 years). Anthropometric measurements (body composition and somatotype), dietetic evaluations, and physical fitness tests (time of movement, handgrip strength dynamometry, Kimono handgrip strength test, vertical jump, and the "sit and reach" test to evaluate flexibility) were performed. Regarding handgrip strength, similar measurements for the dominant (53 kgf, SD: 7, 95% CI 49–57 kgf, range: 42–66 kgf) and non-dominant hand (50 kgf, SD 9, 95% CI 95% 45–54 kgf, range: 36–62 kgf) were found and also for body mass ($r = 0.54$; $p = 0.046$), muscle mass ($r = 0.56$; $p = 0.036$), and total lean mass ($r = 0.60$; $p = 0.022$). A positive correlation was found with the maximal isometric handgrip strength in the non-dominant hand, suggesting that maximal isometric handgrip strength correlates with muscle development.

Mean values of the variables assessed in this study could not be established due to the lack of data reported in the original studies reviewed. Relationships between body composition and handgrip strength variables could not be established in this systematic review due to the heterogeneity of the reported and unreported variables in the selected studies. It was also challenging to compare body composition and handgrip

Table 3. Body composition

Author, Year	Groups	n	Weight (kg)	Height (m)	BMI	BFP (%)	FFM (kg)	LBM (kg)	MMP (%)
Burdukiewicz et al., 2020[16]	M	30	79.1 ± 12.51	1.78 ± 0.54	24.9 ± 2.94	16.4 ± 4.58	NR	NR	62.5 ± 4.12
Detanico et al., 2021[14]	M	20	76.6 ± 10.1	176.4 ± 7.2	24.6 ± 2.3	16.6 ± 5.7	63.4 ± 5.8	NR	NR
	F	23	61.1 ± 9.1	165.3 ± 7.4	22.2 ± 1.9	23.3 ± 2.9	46.7 ± 5.6	NR	NR
Díaz-Lara et al., 2015[10]	M	26	75.4 ± 9.7	176.1 ± 6.1	NR	9.5 ± 2.1	NR	NR	71.2 ± 8.9
Díaz-Lara et al., 2014[11]	M Beginners	24	75.7 ± 9.3	177.1 ± 5.8	NR	9.3 ± 3.7	NR	NR	NR
	M Experts	32	77.4 ± 11.3	175.6 ± 6.6	NR	9.1 ± 4.6	NR	NR	NR
Pietraszewska et al., 2014[12]	M	49	77.3 ± 6.47	177.6 ± 6.4	24.5 ± 1.98	15.7 ± 4.0	84.3 ± 4.0	12.3 ± 3.9	NR
Schwartz et al., 2015[15]	M	136	81.75 ± 13.06	1.74 ± 0.06	26.44 ± 3.38	16.2 ± 6.7	NR	NR	NR
Andreato et al., 2016[1]	M	15	80.3 ± 7.8	177.5 ± 6.4	25.6 ± 2.9	12.7 ± 4.8	69.8 ± 4.3	10.5	59.2 ± 5.0
Andreato et al., 2017[13]	M	10	77.5 ± 6.3	177.1 ± 8.0	NR	10.0 ± 5.2	NR	NR	NR
Andreato et al., 2015[9]	M	10	81.8 ± 7.4	175.9 ± 6.6	NR	13.0 ± 4.8	NR	NR	NR
Rezende et al., 2019[17]	M	12	71.59 ± 13.31	172.66 ± 4.2	23.97 ± 4.08	14.53 ± 8.65	NR	NR	NR
	F	7	67.17 ± 15.37	160.42 ± 7.59	25.84 ± 3.9	22.02 ± 8.2	NR	NR	NR

SD: standard deviation, M: males, F: females, Kg: kilograms, m: meters, BMI: body mass index, BFP: body fat percentage, FFM: fat-free mass, LBM: lean body mass, MMP: muscle mass percentage, and NR: not reported.

Table 4. Somatotype

Author, year	Groups	n	Endomorphy	Mesomorphy	Ectomorphy
Burdukiewicz et al., 2020[16]	M	30	NR	NR	NR
Detanico et al., 2021[14]	M	20	NR	NR	NR
	F	23	NR	NR	NR
Díaz-Lara et al., 2015[10]	M	26	NR	NR	NR
Díaz-Lara et al., 2014[11]	M Beginners	24	NR	NR	NR
	M Experts	32	NR	NR	NR
Pietraszewska et al., 2014[12]	M	49	2.1 (SD 0.62)	5.8 (SD 0.95)	2.0 (SD 0.84)
Schwartz et al., 2015[15]	M	136	NR	NR	NR
Andreato et al., 2016[1]	M	15	3.7 (SD 1.5)	5.3 (SD 2.0)	1.4 (SD 0.9)
Andreato et al., 2017[13]	M	10	NR	NR	NR
Andreato et al., 2015[9]	M	10	NR	NR	NR
Rezende et al., 2019[17]	M	12	NR	NR	NR
	F	7	NR	NR	NR

SD: standard deviation, M: males, F: females, and NR: not reported.

strength due to discrepancies in the types of variables reported, especially in the case of handgrip strength.

This systematic review has several limitations. First, there was a lack of agreement in data reporting between the selected studies, such as the variation in reported and unreported variables regarding body composition. We also reviewed studies with different designs (cohort and cross-sectional studies) and with a low number of participants. The variables concerning somatotype were those reported in the least number of articles (only two of the ten selected studies). There was also high variability in how handgrip strength was reported, with studies reporting maximal isometric handgrip strength, handgrip strength of the right or left hand, and handgrip strength of the dominant or non-dominant hand, making it challenging to compare handgrip strength in the studies selected for the analysis. The variability between the data and how the variables were reported did not allow the identification of relationships between maximal isometric handgrip strength, body composition, and somatotype in BJJ athletes or in establishing normative or average values of these variables in this population. The risk of bias and individual study quality of the studies reviewed could also be of importance, with three of the ten studies assessed being rated as "Low-Quality Studies," one study being rated as a "Fair-Quality Study," two studies being rated as "Moderate-Quality Studies," and four studies being rated as "Good-Quality Studies."

Conclusions

Mean values and relationships between the variables studied in this systematic review could not be established due to the lack of data reported in the original studies reviewed.

It is necessary to standardize in which variables must be reported in this sport and in studies concerning body composition analysis, anthropometric assessment, measurements of different expressions of strength (such as handgrip strength), and somatotyping in BJJ and in other grappling-based combat sports.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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