Profile of the Brazilian Jiu-Jitsu fighter, variables, techniques and instruments for measuring sports performance: A scoping review

Perfil del luchador de Jiu-Jitsu Brasileño, variables, técnicas e instrumentos para medir el rendimiento deportivo: Una revisión de alcance

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Abstract: Aims: To verify a Brazilian Jiu-Jitsu fighter profile studied in the literature and to characterize the variables, techniques and instruments for measuring sports performance. Methods: The review was carried out according to the declaration criteria PRISMA, considering studies between the years 2010 and 2020 in the SportDiscus, PubMed/Medline, SCOPUS, LILACS, Dialnet and SCIELO. Results: A total of 51 studies were chosen, mostly of Brazilian origin (82.4%). The total sample was integrated by 1,493 fighters (98% men), with an average age of 27.1 years. The most assessed variables were the physiological (24 studies) and the physical (13 studies). Of them, the most analyzed were the lactate and grip force, respectively. The assessment instruments most used were the Borg Rating of Perceived Exertion for the physiological variables (13 studies), the dynamometry for the physical variables (13 studies), and the weight scale for anthropometric and nutritional variables (15 studies). Conclusions: It has been generated a Brazilian Jiu-Jitsu fighter profile. The most frequently studied variables were the physiological and physical. The most assessment instrument used were the weight scale, dynamometry and Borg Rating of Perceived Exertion. Moreover, there are few studies that perform measurements in real time, in female fighters, in Brazilian Jiu-Jitsu fighters and who report the fighter style.

Key words: Brazilian jiu-jitsu; assessment; performance; athletic performance; martial arts; sport medicine.

Introduction

The Brazilian Jiu-Jitsu (BJJ) is a grappling combat sport characterized by management techniques and leverage that was born in Japan, later it arrived to Brazil in 1915, which was improved by Carlos Gracie (Del Vecchio et al., 2007). Regarding its popularity, emerges through the significance that developed in the world championship starting in 1996, organized by International Brazilian Jiu-Jitsu Federation (IBJJF), Nowadays, the BJJ is developed in many countries and particularly in the last ten years it has been a substantial growth in BJJ popularity, part of this, must be to success of the BJJ athletes in mixed martial arts events (Andreato et al., 2016).

Regarding the characteristics of the BJJ, the athletes star in the fight standing up, however, the techniques allowed in competition are: projection of the opponent, immobilization, chokes, twists and on the other hand,
hyperextensions of the joints are not allowed (da Silva et al., 2016). On the contrary, if there is no submission, the fights are determined through the specific punctuation obtained from performed techniques (takedown, guard pass, mount, rear mount, back control, belly knee and sweep), and in case of dead heat by arbitrator decision (Andreato et al., 2017).

The BJJ most commonly physical characteristics are: muscular strength (Yates, 2017), hand grip (Corrêa et al., 2014), isometric strength (Corrêa et al., 2017), flexibility (Andreato et al., 2011) aerobic capacity (Pinheiro et al., 2011) and anaerobic capacity (Corrêa et al., 2014), and perception of effort (Detanico et al., 2017) measured by rating perceived exertion (RPE) as a result measure that allows to establish and dose exercise intensity (Zambrano & Manterola, 2016).

Physical capacities and abilities are required in order to endure BJJ training and competitions, given to intermittent efforts characteristics, with alternating high and low intensity stimulus (Villar et al., 2018), regarding the intermittency of the BJJ, the effort / pause ratio reported in the matches has been from 6: 1 to 13: 1, with periods of effort of 85 to 290 seconds and pauses of 5 to 44 seconds, respectively (Andreato et al., 2016). The BJJ has intermittent characteristics, therefore grapplers need a specific physical condition to withstand training and competitions, in this line the aerobic power provides the possibility of maintaining high intensity during combat, preventing fatigue and benefits recovery; muscle strength used for attack-defense movements and specific techniques; muscular endurance to maintain grip on the opponent’s gi; and flexibility, which helps in specific attack or defense situations (Andreato et al., 2017).

In terms of BJJ psychological characteristics stand out: Stress (Campos et al., 2020), mood and anxiety, is consider that athletes show behaviors and similar patterns described in other sports, its means, an iceberg profile (Andreato et al., 2014). Nowadays, is found an increasing study body in relation to the performance parameters and its evaluation in different grappler combat sport, in the same way, Olympics sports have been researching such Judo and wrestling (Chaibene et al., 2017). However, there is a research lack about BJJ (Øvretveit, 2018a, Andreato et al., 2017, Andreato et al., 2015).

Regarding, existing BJJ researches aimed at knowing the variables related to the evaluation of physical and psychological parameters, there is a divergence between the physical and psychological variables that are most related to sports performance, as well as with the evaluation methods and measurement instruments used. As an example, for the strength evaluation method for the upper body segments of BJJ athletes, it has not been determined which is the best (Detanico et al., 2017), even in essential physical conditions for optimal performance of the fighter, there are contradictory results, where some authors show a decrease in the isometric strength of the grip measured after a simulated competition fight and other studies describe that the isometric strength does not decrease (Corrêa et al., 2017), even decreased grip strength only in the dominant hand (Andreato et al., 2014).

Nowadays, the sports are evolving to an improvement of physical-physiological, without diminishing the importance of the rest of the factors involved such as technical-tactical aspects, which is why it is necessary to create and use instruments that evaluate the physical component of the athlete, in order to know their performance (Mancha et al., 2019).

The BBJ has been gaining followers and more and more athletes who practice it, despite the increase in popularity of this sport, there is still little evidence of scientific evidence focused on this sports discipline. We were chosen as the study design a scoping review, to clarify and characterize concepts according to BJJ. This type of study is useful to explore areas of the literature in an exhaustive way (Peters et al., 2015). Thus, the scoping review will allow us to describe the fighter’s profile and the instruments used to assess their sport performance, also will allow us identify knowledge gap and suggest recommendations for future research. In this line, the aims of this review were to verify a Brazilian Jiujitsu fighter profile studied in the literature and to characterize the variables, techniques and instruments for measuring sports performance.

**Methods**

The scoping review was carried out in accordance with the norms established by the PRISMA 2020 statement (Figure 1) (Page et al., 2021). The PRISMA checklist can be found in the supplementary material (Table S1). The manuscript was not registered in PROSPERO. PROSPERO does not currently accept registrations for scoping reviews, literature reviews or mapping reviews.

**Search strategy to identify studies**

A scoping review was developed in the following
PubMed/Medline, SCOPUS, SportDiscus, SCIELO and Dialnet. All the articles published in the available databases that studied the characteristics, variables and instruments to assess sports performance in BJJ fighters were identified. For effects, keywords were obtained, on which the general search syntax was generated: «Brazilian Jiu Jitsu» AND «performance» OR Assessment. These words were used in English, Spanish and Portuguese, according to the database. Thus, «Brazilian Jiu Jitsu», «performance» and valuation, «performance» and avaliação were used. The search was limited to the period between January 2010 and August 30, 2020. This period of time was decided to obtain the most updated data on the BJJ fighters profile, the variables and measurement instruments used in these athletes. The complete search strategy in all databases is presented in the supplementary material (Table S2).

Studies selection

Systematic reviews, editorial documents, experimental studies, protocols, or theses were not included. The articles selected by title and abstract had to meet the inclusion criteria were selected and, when the conditions indicated in Table 1.

Table 1.

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<th>Criteria</th>
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| 1) Brazilian Jiu Jitsu | a) Works that study related Brazilian Jiu Jitsu
  b) Anos aspects of sports performance in practitioners graduated or not of Brazilian Jiu Jitsu, in situations of official competition, training or evaluations of the physical determinants related to the discipline.
  c) Male and female Brazilian jiu-jitsu wrestlers of amateur and/or professional adult level, master 1 and 2.
  d) Active fighters either by competitive terms at the national level professional adult level, master 1 and 2.
  e) Evaluations of the physical determinants related to the discipline.
| 2) Assessment and psychological variables | a) Anxiety, stress, mood, concentration y attention. performance
  b) Physical variables: qualities of muscle strength, grip strength, aerobic capacity, anaerobic capacity, flexibility, perception of effort.
  c) Assessment of performance variables: sports achievements such as national, Pan-American, world.
  d) It includes evaluative instruments: batteries, questionnaires, surveys, electronic devices, laboratory analysis and field tests.
| 3) Type of article | a) Original analytical articles (descriptive of case and control, cohort and longitudinal, etc.)
  b) Publications from January 2010 to August 30, 2020.
  c) English language, Portuguese and Spanish. |

Data extraction

In the first instance, duplicate articles were removed using the Mendeley program, then, two independent reviewers (C.R-H and J.R-B.) applied inclusion/exclusion criteria to all titles and summaries. Articles that met the inclusion criteria were selected and, when decisions could not be made on the title and abstract alone, the full-text documents were also retrieved. The selected articles and were independently verified by the same two reviewers (C.R-H. and J.R-B.); however, when there were discrepancies, a consensus was reached with a third reviewer (I.C.). Then, data were independently extracted by the same reviewer (C.R-H. and J.R-B.) and entered into a prepared Excel spreadsheet (Excel, Microsoft Corporation, Redmond, Washington, USA. Finally, the main results are presented in summary tables and figures.

Risk of the bias assessment tool

The Newcastle–Ottawa Scale (NOS) tool was used. This scale assesses the quality of non-randomized studies. It is composed of eight items, divided into three dimensions (comparison, selection, type of study) of cross-sectional, cross-sectional or case-control investigations (Lo et al., 2014). NOS assesses the risk of bias from 0-9 stars. The higher the number of stars, the lower the risk of bias. NOS considered a high risk of bias 6≤ stars and a low risk of bias 7< stars (Lo et al., 2014). NOS has been used as in other studies (Ortiz Sánchez et al., 2020). The results of this analysis are presented in Table 2. Each article was independently graded by two reviewers (C.R-H and J.R-B), and the scores were compared. When there was disagreement, consensus was reached with a third reviewer (I.C.).

Strategy for data synthesis

A narrative synthesis of the findings was provided from the included studies and the main information is presented in summary tables and figures. The results were ordered to present the PRISMA flow diagram (Figure 1). The general characteristics of the articles (author, country, year, sample, retirement, retirement cause, gender, age range, average age) (Table 2); methodological characteristics of the articles (focus, scope, timing) and risk of bias assessed using the Newcastle-Ottawa questionnaire (Table 3); Fighters characteristics (BJJ category, athlete situation, measurement situation, fighter style (Figure 2); analysis variables (psychological, physiological, physical, anthropometric) (Figure 3); Assessment instruments according to each variable (questionnaires, interviews, direct and indirect methods, field tests, laboratory tests) (Figure 4).

Results

Literature search

In the initial search, 345 scientific articles were identified, of which 62 articles were duplicates. After reading by titles and abstracts, 211 studies were excluded for not addressing the inclusion and exclusion
General characteristics of the studies

A total of 51 studies were included, of these, 82.4% of origin in Brazil. 80.4% of the studies were concentrated between 2014 and 2020. The initial sample corresponded to a total of 1,583 BJJ fighters of which 5 fighters withdrew due to incomplete data (0.31% of the total population), so the final sample was 1,493 BJJ fighters (98% male; 27.7 years’ average). Regarding the age range of the fighters, 96.1% were between 25-40 years old and 70.6% between 18-24 years old. (Table 2).

Risk of bias and methodological characteristics of the articles

The table 3 shows the methodological characteristics of the selected studies. The study designs were mostly analytical (64.7%). The largest number of studies corresponded to observational design (31.4%) and cohort (29.4%) and case-control (25.5%) studies. The most frequent scope was comparative (55%) and most of the studies had a transversal temporality (55%). According to the Newcastle Ottawa scale, 51% of the studies were at high risk of bias (Table 3).

 Fighters characteristics

Regarding the sporting level of the fighters, 43 studies included advanced category fighters (purple (roxa), brown and black belts), 29 novices (white and blue belts) and six elite ones.

Most of the studies were conducted on BJJ fighters (n = 50 studies) and only 1 study on Jiujitsu wrestlers. The studies were carried out in training sessions, without a competition situation (n = 23 studies), followed by
simulated competition situations (n = 19 studies) and only nine studies were carried out in a competition situation. Of these, international competitions were the most frequent (n = six studies). In most of the studies, BJJ’s wrestling style was not indicated (47/51) and only most frequent (n = six studies). In most of the studies, the figure 4 describes the distribution of the analyzed variables, which were grouped into six categories (a) psychological, (b) physiological, (c) physical, (d) technical-tactical, (e) anthropometric and (f) nutritional (Figure 3).

b) Psychological variables: eight variables were found. The most frequent were mood in four studies, anxiety and level of recovery in two studies.

c) Physiological variables: 24 variables were found. The most frequent were lactate 17 studies, RPE / Borg 15 and Heart rate 12 studies.

d) Physical variables: 13 variables were found. The most frequent were prehensile / grip strength 20 studies, lower limb power 12, upper limb strength seven, and flexibility with six studies.

e) Technical and tactical variables: Only two variables, which were technical and tactical with five studies respectively.

f) Anthropometric variables: five anthropometric variables were found. The most frequent were body weight and height with 11 studies, and body composition eight studies.

g) Nutritional variables: three variables were found, intake of macronutrients / micronutrients four studies.

**Assessment instruments**

The figure 4 describes the instruments used for the assessment of the analyzed variables, which were grouped into four categories (a) psychological, (b) physiological, (c) physical and (d) anthropometric and nutritional. The technical-tactical variables used video analysis and not considered in the figure and the anthropometric variables were unified with the nutritional ones.

Assessment instruments for psychological variables: seven instruments were found. The most frequent were Brunel Mood Scale; four studies and State Competitive Anxiety Inventory 3 studies.
a) Instruments for assessing physiological parameters: 12 instruments were found. The most frequent were RPE / Borg scale 13 studies, heart rate monitoring ten studies, portable lactate analyzer and biochemical analysis nine studies each.

b) Instruments for assessing physical parameters: 20 instruments were found. The most frequent were dynamometry with 13 studies, Suspension Gripping a Kimono Test nine studies, jump platform and Sit and Reach with seven studies respectively.

c) Instruments for assessing anthropometric and nutritional parameters: six instruments were found. The most frequent were weight scale 15 studies, height rod 14 studies and plicometer with ten studies.

Discussion

What are the main results?
The main results of this scoping review are grouped in relation to the profile of the fighter, the variables, and instruments most used in the literature to analyze the BJJ performance. The studies mainly analyzed BJJ male fighters, originally from Brazil, with an age ranging between 25-40 years, from advanced categories and who were in training situations.

In relation to the variables, six types were analyzed, the most frequent were physiological variables (24 variables) physical variables (13 variables) and of these the most analyzed were lactate and grip strength, respectively. Regarding the valuation instruments, the most used were; for psychological variables the Brunel Mood Scale (four studies), physiological variables the RPE / Borg scale (13 studies), physical variables dynamometry (13 studies), technical-tactical variables the video analysis (three studies) and for anthropometric variables and nutritional balance (15 studies).

What was known before this review?
This review synthesized the studies of the last ten years that used the methods of evaluating sports performance in BJJ fighters, the psychological, physiological, physical, technical-tactical, anthropometric and nutritional variables were observed. The studies reviewed contained a profile of the fighters, which stands out for analyzing young male athletes of Brazilian origin (27 years) who probably, given their origin (Brazil), concentrate the majority of BJJ fighters (Vicentini & Marques, 2019).

This suggests that there is still a lack of studies that use other populations, for example, Paraju-Jitsu (Santos et al., 2019), of which only 1 study was found that uses fighters with disabilities as a population to investigate. Additionally, regarding female fighters, there are few studies in this population, therefore, there is no evidence of what their profiles could be (Spanias et al., 2019). This information would be of great value for this discipline, considering that similar fighting sports such as judo show contradictory results in physical aptitude.
Only 9 studies were found with measurements of situation in real competitions, this may be due to the complexity of the sampling and the invasive nature of some physiological measurements, which could eventually disrupt mental strength, since it is in sports of Combat is a determinant of success both in tournaments and in the training environment (Slimani et al., 2016).

A low percentage of abandonment of wrestlers was observed in the studies (0.31%). It was not expressly mentioned if the evaluated athletes abandon for any reason, no withdrawals were recorded due to an injury or accident attributable to sports practice. Only one study mentioned abandon due to not meeting criteria. These results suggest that, despite the nature of the sport, the athletes studied could be a safe and adherent population for conducting studies in this area.

In relation to the study variables, it was determined that the most studied psychological variable was the state of mind. This is relevant since it has been observed that psychological states prior to competition are one of the predictive factors of sports performance in a wide range of sports (González Hernández & Valadez Jiménez, 2016; Keikka et al., 2015). At a physiological level, lactate is the most frequent followed by perceived exertion and heart rate to a lesser extent. There are difficulties in measuring physiological demands in BJJ, due to the complexity of gas analysis measurements during the BJJ, alternative markers have been used such as heart rate, blood tests, salivary evaluations and rating of perceived exertion (RPE) (Andreato et al., 2016).

The lactate measurement is relevant as some studies have shown an increase in blood lactate concentration in successive BJJ matches (Andreato et al., 2015), in turn, a decrease in the accumulation of delta lactate during the sequence of matches (which suggests a decrease in the activation of the glycolytic pathway during the simulation of competition) (Abad et al., 2016). Within the physical variables, the grip or grip strength...
is the most frequent, this is attributed to the characteristics of grappling sports such as Brazilian Jiu Jitsu, judo and Olympic fighting, where there is a great demand for isometric grip strength resistance, to achieve immobilizations, knockdowns, throws and submissions (Andreato et al., 2017). The power of the lower limbs and the strength of the upper limbs are also frequent in studies, this reaffirms the relevance of this component in the development of sport (Ovretveit & Toien, 2018) (Correa et al., 2015) Similar to what occur in grip sports like judo (Norambuena et al., 2021), and as a differentiating physical conditioner in the profiles of wrestling athletes successful (James et al., 2020).

Another variable identified was the technical-tactics, these are of interest due to the intermittent demand that occurs in the fighting phases, with attention to attacks and skills (Miarka et al., 2016). Anthropometric variables highlight weight and height more frequently, this could indicate what usually happens in fighting sports where body mass is manipulated, with acute weight loss in MMA being greater prevalence and magnitude (Barley et al., 2017). In addition, for the importance of body composition in the development of high performance (Borges et al., 2016).

Regarding the instruments, the Brunel Mood Scale was found to assess mood, this stands out mainly because it has been used and validated in multiple countries for different populations, such as athletes, adolescents, people with disabilities, among others (Lan et al., 2012).

Scales of perceived exertion (RPE / Borg) are essential because the RPE can be used in a variety of competitive levels and genders to monitor workload, so physical exertion can play a more important role than mental exertion when athletes reflect on effort during training (Bromley et al., 2018).

Dynamometry was the most widely used instrument for the assessment of physical variables. Grip strength measurements are very specific for sports of grip modalities, especially in those that use kimono, as is the case of BJJ (Kons et al., 2020). In addition, grip strength is an objective index of the functional integrity of the upper limb, it is evaluated by dynamometry, since it is a cheap, fast and easy to use technique that also serves to detect the loss of physiological muscle function (Rojas et al., 2012). The technical-tactical variable was mostly recorded by video analysis, which allows to know the structure of time and movement of the combats, since the time and pause of the actions of the fighters may be different according to the duration of the combat (Andreato et al., 2016) which is necessary to identify to plan the preparation of athletes. The most widely used anthropometric instruments were the height rod and scale, this can be attributed to the fact that they allow knowing indices of the body structure of a fighter, thanks to which a specific change in physical structure can be observed according to the type of combat sport (Dopsaj et al., 2017) and differ between fighters with different fighting styles (Báez et al., 2014).

What are the strengths and weaknesses of this review?

An analysis of studies collected in the last ten years was carried out that allow us to indicate that there is a lack of qualitative information about the assessment instruments for the performance of BJJ fighters. Which provides an opportunity to develop new lines of research on the development of assessment methods according to sports demands.

Likewise, it was evidenced that the evaluation instruments collected are easily accessible, without the need for high-cost tools. This provides the technical team with the fundamental tools to objectify these variables.

The main limitation for this systematic review was that the studies to a large extent present low methodological quality according to the NOS, consequently there is low research production in this sport, mostly concentrated in Brazil.

Contributions to the discipline and practical implications

The existing literature on the aspects of sports performance assessment in BJJ is limited. In the same way, no systematic reviews have been found that address the analysis of specific instruments for the different aspects of the psychological, physiological, physical, technical, nutritional field of the sphere of the fighter of this sport. Thus, this is the first scoping review that delves into the characteristics of the study population, the methodological aspects of the BJJ studies, the characteristics of the BJJ fighters and the identification of the most frequent variables and assessment instruments used for the last 10 years in BJJ fighters. In addition, this review characterizes the most studied profile of BJJ fighters, which allowed to generate an updated profile of BBj fighters. Besides, this study helped identify the variables of analysis, techniques and measurement instruments most used today. This information could be used for the evaluation and planning of these athletes.
Conclusion

It is concluded that the profile of the BJJ fighters was: BJJ fighters, mostly men, from Brazil with an average age of 27 years, from advanced categories and who were found in training situations. In relation to the variables, techniques and instruments to measure sports performance: Lactate and RPE / Borg were the most analyzed physiological variables, grip strength and lower limb power were the most analyzed physical variables, and body weight and height variables were the most analyzed anthropometric variables. The most widely used assessment instruments were the weight scale, dynamometry and RPE / Borg.

In addition, it was shown that there are few studies that perform measurements in real competition, in female fighters, in for BJJ fighters, as well as that report the style of the fighter. We encourage researchers to focus their efforts on addressing these knowledge gaps.

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Interest conflict

The authors stated that they have no conflict of interest.

References


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