Endurance in *judogi* grip strength tests: Comparison between elite and non-elite judo players

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Abstract

Background and Study Aim: The ability to develop a strong grip and maintain it during a judo match has become an important element for judo athletes. Therefore, the purpose of this investigation was to examine differences between measurements of maximal isometric time on *judogi* pull-up, and number of repetitions during dynamic *judogi* pull-up.

Material/Methods: The sample was composed by two groups: 16 high-level judo athletes from the male Brazilian National Team and 12 male state-level judo athletes, with at least one athlete per weight category. The tests were compared through analysis of co-variance (body mass as co-variable), followed by a post-hoc test (Scheffé). Significance level was set at 5%.

Results: No difference was found in the isometric test: Brazilian Team: 35±18s; Regional: 39±14s. However, the Brazilian Team performed a high number of repetitions (12±5 rep) compared to regional group (9±4 rep) during the dynamic grip strength endurance test.

Conclusions: Thus, dynamic grip strength endurance seems to be a discriminating variable between judo athletes, probably because judo combat involves many elbow extensions and flexions in order to avoid the opponent's grip and to subdue them.

Key words: judo • high-level athletes • specific strength exercise • hand-grip strength • strength endurance • judogi

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Background

Judo can be characterized as a high-intensity, intermittent sport with a wide complexity in motor control, where athletes attempt to throw their opponents or to dominate them during groundwork combat [1–3]. There are constant dynamic changes during a combat, and judo athletes require a combination of strength and endurance during grip combat (*kumi-kata*) to control the distance between them and their opponent [4–7]. Furthermore, this arrangement is responsible for adaptations of techniques and tactical skills for new attacks, defense or counter-attack actions [7]. Therefore, the ability to rapidly mobilize a strong grip and pull or push the opponent is a highly valued attribute in judo athletes [8].

Authors consider strength and endurance as potential predictors of judo performance [2,9,10]. However, maximal strength data in regular exercises such as rowing, bench press and squat tests are not largely described in investigations concerning judo athletes [2–4]. Although investigations with maximal handgrip strength have been used, results are not consensual and the few available ones measured pull and grip components with specific approaches to combat situations, that are essential for judo athletes [11–13].

Judo – literally means "the way of gentleness". Nowadays is an Olympic sport involving throwing, grappling, strangles, and elbow-joint lock techniques.

High-level athletes – in the present text, this term was used to define international level judo competitors.

Some researchers [8] did not observe significant difference in handgrip strength when comparing elite and non-elite judo players. On the other hand, authors [14] have described a significant correlation between static strength and competitive success in Japanese judo athletes. Although the maximal handgrip test has been used to evaluate maximal isometric grip strength, it is not considered appropriate to measure specific judo grip strength [1]. A dynamic measurement method used to verify possible differences between athletes from different competitive levels can be more appropriate for this specific strength evaluation.

Several training strategies have used pull-ups with *judogi* hanging from the pull-up bar in order to improve isometric handgrip and dynamic pulling strength endurance [15], also generating some studies regarding their effectiveness [16]. Thus, the purpose of this investigation was to compare the maximal isometric endurance time on *judogi* pulling and the number of repetitions during *judogi* pull-up in judo athletes from different competitive levels.

Material and Methods

Experimental approach to the problem

In order to address the first goal of the present study, two different groups of judo players were monitored throughout a competitive season during separate occasions. Similar to other sports, physical conditioning plays a large role in the preparation and subsequent performance of judo athletes. Although many physical attributes are required for a successful performance in judo contests, in this study we focused on strength endurance measurements. Both maximal isometric time on *judogi* pulling and number of repetitions during *judogi* pull-up test were assessed. As pointed above, *judogi* strength exercises, in which athletes uses grips similar to that during the match, are largely used to improve isometric and dynamic hand-grip strength endurance. Since in judo there is no proper specific upper-body strength test that reproduces the gripping on the *judogi,* in the present study we proposed this specific exercise as a test in order to compare athletes of different competitive levels.

This investigation was conducted with a group of male elite judo athletes in a professional environment and international level (Brazilian Team), and a group of male state level athletes (Grêmio Recreativo Barueri Team). Athletes were evaluated during their competitive period.

Subjects

Twenty-eight male judo players, with more than 10 years of judo practice, participated in this study. They were divided in two groups: 16 high-level athletes from Brazilian National Team (87.5±24.3 kg of body mass and 176.8±8.4 cm of height) and 12 state level athletes from Grêmio Recreativo Barueri (São Paulo state) (77.9±16.4 kg of body mass and 179.4±9.3 cm of height, $p>0.05$ for both variables between groups), with at least one athlete for each weight category. All athletes were informed about the procedures involved and signed an informed consent document before the investigation. This study was approved by the local Ethics Committee.

Judogi's isometric and dynamic strength endurance test

Two *judogi* strength endurance tests were performed: (1) isometric – while holding on *judogi* rolled around the bar, with the elbow joint in maximal flexion, athletes were required to sustain this position (*judogi* isometric pulling) during the maximal possible time, measured in seconds; (2) dynamic – during this test the same grip position was applied, but athletes performed the maximal number of repetitions from a fully flexed to a fully extended elbow position (Figure 1). In both cases, athletes performed the exercises until voluntary failure and a minimum of 15 min rest was allowed between each test. The reliability for both tests was assessed in a previous study, which reported an intraclass correlation coefficient of >0.98 [16]. Measures were also expressed as body mass ratio, as the bar test involves sustentation of the athlete's own body mass as well. The tests described were conducted in order to verify the factors that possibly determine the abilities to maintain grip on the *judogi* during suspension or repetition, Figure 1.

Statistical analysis

Data are presented as mean ± standard deviation (SD). The results were compared by an analysis of co-variance (body mass as co-variable). The test was conducted in order to compare the measured variables. When differences were detected, the Scheffé *post-hoc* correction was used to identify specific differences between the groups. Statistical significance was considered achieved when the value of P was <0.05.

Results

Table 1 presents results in absolute and relative values of *judogi* grip isometric endurance strength and *judogi* grip dynamic endurance strength in judo athletes from the Brazilian National Team and Grêmio Recreativo Barueri Team.

Groups differed in the number of repetitions during the dynamic endurance strength on *judogi* grip, but not on the maximal isometric time on *judogi* grip test.

Figure 1. *Judogi's* Isometric (**Panel B**) and Dynamic Strength Endurance Test Positions (Initial phase: **Panel A**; test ending: **Panel B**.

Specific strength exercise – any exercise with similar strength requirements similar to the main activity (in our article it refers to judo).

Hand-grip strength – the ability to exert force while grasping an apparatus with one hand.

Strength endurance – muscle's ability to perform a maximal or submaximal contraction time after time.

Judogi – uniform used to practice judo.

Table 1. *Judogi* grip isometric endurance strength and *judogi* grip dynamic endurance strength in judo athletes from the Brazilian National Team and Grêmio Recreativo Barueri Team.

Variables	Brazilian Team	Barueri Team
Absolute values		
Maximal isometric time on judogi grip (s)	35±18	39±14
Dynamic endurance strength on judogi grip (rep)	12±5	9±4*
Relative values		
Maximal isometric time on judogi grip (s/kg)	0.5±0.3	0.5±0.2
Dynamic endurance strength on judogi grip (rep/kg)	0.2±0.1	0.1±0.1*

Data are presented as mean ±SD. * *P*<0.05 *vs.* Brazilian Team.

Discussion

The present study verified that the isometric version did not differ between judo athletes with different levels of competition achievement. However, the Dynamic *Judogi* Strength Endurance Test was able to correctly discriminate between judo athletes from different competitive levels ($p<0.05$).

This result is in agreement with some authors [8] who showed that isometric strength was similar between elite and non-elite judo players. The results from the present study seem supported by the fact that although the forearm performs an intense isometric action during the *kumikata*, other muscle groups act dynamically. Thus, a test that considers both the isometric action of the forearm muscle as well as the dynamic action of the arm and back muscles has more potential to properly discriminate judo athletes from different competitive levels. In fact, researchers [17] found that the normalized thickness of the elbow flexor and extensor were larger at international level compared to university level judo athletes who did not take part in competitions, and had a larger elbow flexor than in a group of university judo players who participated in competitions. These differences, as well as the differences found in the present study, could be attributed to the fact that during the period of combat both athletes try to throw and restrain the opponent by holding the collar and sleeve of the judo jacket of the adversary.

When a judo player is holding the opponent's jacket and wants to increase the distance from the adversary, it is necessary to extend the elbow joint. Conversely, to reduce the distance from the opponent it is necessary to flex the elbow joint. Differences in strength and endurance in order to perform these movements more effectively might influence judo performance. Additionally, as these tests involve sustentation of the athlete's own body mass, they guarantee a direct relation to the weight category. Thus, considering that some authors suggest that strength endurance is important for judo performance [2,9,13,14] the dynamic *judogi* strength endurance test can be included to evaluate judo athletes, together with other tests related to judo performance

[2,8,18–20]. Thus, a judo specific test battery should be proposed as used in other combat sports [21–23].

Conclusions

In conclusion, this study demonstrated that while the isometric version of this test was not able to properly discriminate judo athletes from different competitive levels, the Dynamic Judogi Strength Test can be successfully used to do it.

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