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Section: Original Investigation

Article Title: A Moderate Dose of Caffeine Enhances High-Intensity Actions and Physical Performance During a Simulated Brazilian Jiu-Jitsu Competition

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ABSTRACT

Purpose: Although caffeine is one of the most commonly used substances in combat sports, information about its ergogenic effects on these disciplines is very limited. The aim of this investigation was to determine the effectiveness of ingesting a moderate dose of caffeine to enhance overall performance during a simulated Brazilian Jiu-jitsu (BJJ) competition.

Methods: Fourteen elite BJJ athletes participated in a double-blind, placebo-controlled experimental design. In a random order, the athletes ingested either 3 mg·kg⁻¹ body mass of caffeine or a placebo (cellulose; 0 mg·kg⁻¹) and performed two simulated BJJ combats (with 20 min rest between them), following official BJJ rules. Specific physical tests such as maximal handgrip dynamometry, maximal height during a countermovement jump, permanence during a maximal static lift test, peak power in a bench press exercise and blood lactate concentration were measured at three specific times: prior to the first combat and immediately after the first and second combat. The combats were video-recorded to analyze fight actions.

Results: After the caffeine ingestion, participants spent more time in offensive actions in both combats and revealed higher blood lactate values (P<0.05). Performance in all physical tests carried out before the first combat was enhanced with caffeine (P<0.05), and some improvements remained post-first combat (e.g. maximal static lift test and bench press exercise; P<0.05). After the second combat, the values in all physical tests were similar between caffeine and placebo.

Conclusion: Caffeine might be an effective ergogenic aid for improving intensity and physical performance during successive elite BJJ combats.

Keywords: performance, stimulants, fight, exercise, ergogenic aids.
INTRODUCTION

Caffeine (1,3,7-trimethylxanthine) is a psychoactive drug present in the leaves, fruits and seeds of various plants and is commonly consumed in natural and commercial foods and drinks.\(^1\) Furthermore, caffeine can be artificially synthesized and is frequently included in nutritional supplements and energy drinks. The ergogenic effect of caffeine appears to result from alterations in the central nervous system, mainly because caffeine acts as a potent adenosine receptor antagonist, reducing the “fatiguing” effects of adenosine.\(^2\) Peripherally, caffeine inhibits phosphodiesterase activity and increases plasma catecholamine and glycolysis activity, enhancing energy availability for active muscles during exercise.\(^3\)

In spite of the popularity of caffeine among grappling sports athletes, few investigations have studied the effects of caffeine on combat sports performance, and their results are controversial. Caffeine doses of 5-to-6 mg·kg\(^{-1}\) ingested before exercise have not been shown to increase performance in specific performance tests in judo\(^4\) and wrestling.\(^5\) However other research carried out with combat sports athletes (e.g. judo and taekwondo) and with similar doses of caffeine found increased values for peak and mean power during the Wingate test, reduced simple reaction time during a computer-based test of visual stimulus,\(^6\) enhanced performance in a specific combat task and delayed fatigue during successive taekwondo combats.\(^7\) However, the results of previous investigations about the effects of caffeine on anaerobic performance,\(^8-10\) muscular power in upper and lower limbs\(^11,12\) and strength endurance\(^13\) are difficult to apply to the intermittent nature of combat sports.\(^14,15\) The different doses of caffeine administered, the tests used and the characteristics of each combat sport make it difficult to draw conclusions with regard to combat sports, such as Brazilian Jiu-jitsu.
Caffeine could be proposed for improving performance in combat sports because of its known effects on physical performance in other intermittent-like disciplines such as team sports. However, the limited number of investigations on this topic precludes affirming whether caffeine should be recommended to combat sports athletes before competition. The main purpose of this investigation was to determine the effectiveness of ingesting a moderate dose of caffeine (3 mg per kg of body mass) to enhance overall performance during a simulated Brazilian Jiu-jitsu competition. We hypothesized that the pre-competition ingestion of caffeine would increase the intensity of the fight, and the number and duration of successful actions during the fight.

MATERIAL AND METHODS

Subjects

Fourteen elite Brazilian Jiu-jitsu athletes volunteered to participate in this investigation. They had a mean ± SD age of 29.2 ± 3.3 yr, body height of 173.8 ± 6.2 cm, body mass of 71.3 ± 9.1 kg, body fat of 8.5 ± 1.5 % and body muscle mass of 51.6 ± 3.3 %. All the participants were categorized as elite because they had won the National Spanish championship in their respective categories or had ranked among the first 3 classified in an international championship during the year of the study. All participants had prior Brazilian Jiu-jitsu experience of a least 5 years and had trained for ~ 2 h·day⁻¹, 4 days·week⁻¹ during the previous year. They were free of injuries, were not taking medications or supplements for the duration of the study, were non-smokers and were classified as light caffeine consumers using dietary recalls. Participants were fully informed of any risks and discomforts associated with the experiments before giving their informed written consent to participate. The study was approved by the Camilo José Cela University Review Board in accordance with the latest version of the Declaration of Helsinki.
Experimental design

A double-blind, placebo-controlled experimental design was used in this study. Each athlete took part in 2 experimental trials at the same time of day and under well-controlled conditions (21.0 ± 0.5°C dry temperature; 30 ± 5% relative humidity) separated by one week to allow complete recovery and caffeine washout. In each experimental trial, athletes ingested an opaque capsule with an individualized dose of 3 mg of caffeine per kg of body mass (99% pure, Bulkpowders, UK) or an identical capsule filled with cellulose (0 mg·kg⁻¹ of body mass; placebo). This dosage was selected because previous investigations in individual and team sports have found ergogenic effects with this dosage while the side effects were minimal. The order of the experimental trials was randomized and counterbalanced for all participants. An alphanumeric code was assigned to each trial to blind participants and investigators to the substance tested in each experimental trial. This code was disclosed only after the analysis of the variables.

Experimental protocol

The day before the first experimental trial, participants were nude-weighed to calculate the caffeine dosage and the anthropometric characteristics were measured by an International Society for the Advancement of Kinanthropometry certified anthropometrist. A power-load test was performed in bench press to determine the individual load at which maximal muscle power was obtained and was used to calculate maximal muscle power in the two subsequent experimental trials. After this, and for the 2 week duration of the intervention, participants refrained from strenuous exercise, adopted a similar diet and fluid intake regimen, and were encouraged to eliminate all dietary sources of caffeine and alcohol for 48 hours before each testing session. These standardization procedures were registered and mimicked before each experimental trial.
The experimental trials were carried out in the facilities for grappling sports belonging to the Spanish High Council for Sport. Three hours before the start of the tests, participants had their habitual pre-competition meal which was replicated before the second experimental trial. Participants ingested the assigned capsule and they performed a 15-min standardized warm-up. Sixty min after the ingestion of the caffeine/placebo capsule, they performed several physical tests (see Figure 1).

**Simulated BJJ combats**

In each experimental trial, participants performed two 8-min simulated combats in accordance with the 2014 International Brazilian Jiu-jitsu Federation’s official rules. The combats were set to match the two fighters by weight category (less than 10% difference in body mass). The same opponents were maintained for all combats and experimental trials. The fights were separated by 20 min rest (time for data collection and passive recovery). The fight was subjectively categorized as low or high intensity according to the system defined by Andreato, et al. 20, marking the intensity of each individual action. A high-intensity offensive action was identified when the fighter tried to advance, progress, or evolve with clear vigor, muscle strength, or power (e.g. takedown, guard pass), whereas a high-intensity defensive action was identified when the fighter tried to escape or avoid a disadvantageous position with the same vigor, etc. (e.g. escape from a immobilization technique). A neutral action was identified when any fighter clearly tried to advance or in actions that were performed at low intensity. Each change of action was considered as a block. Lastly a simplified analysis based on the total number of successful offensive actions by each fighter was computed. Any offensive action performed by athletes during the combat, either advantage, points or submissions, according to the International Brazilian Jiu-jitsu Federation’s official rules, was computed as one successful action. For this technical analysis, three video cameras
Handycam HDR-XR200VE, Sony, Spain) were positioned at different corners of the mat to record fight actions at 30 Hz for later off-line analyses. Afterwards, two trained and experienced observers, blinded to the treatments, analyzed the fight using Sony Vegas Pro 8.0 software (Sony, USA). This type of analysis has been reported to be both objective and reliable, as it is used to determine the score and has an intra-class correlation coefficient (ICC) greater than 0.90.

Four measurements of blood lactate, using a 0.2 µl sample taken from the fingertip, were made during each experimental trial: before and just after the first and second fight. The blood lactate concentration was determined using a portable blood lactate analyzer (Lactate Scout, Germany) with an enzymatic-amperometric biosensor as the measuring element.

**Physical Tests**

Thirty min before the first combat, participants performed one concentric arm extension in a bench press exercise as fast as possible with the load at which they had obtained their maximal muscle power (e.g. 45.1 ± 12.9% of 1RM); (see above). Then, the participants performed a handgrip maximal force production test with both hands using a handgrip dynamometer (Grip-D, Takei, Japan) with and accuracy of 1 N. The participants then performed a maximal countermovement jump on a force platform (Quattro Jump, Kistler, Switzerland) with a sampling frequency of 500 Hz and an accuracy of 1 N. The participants subsequently performed a maximum static lift test to determine upper-body muscle endurance. The maximum static lift is a useful and reliable test (e.g. ICC=0.97) to discriminate BJJ athletes from different levels. For this test, we followed the protocol by Corrêa da Silva, et al. with participants performing a grip exercise holding on to a uniform jacket rolled around an elevated bar (2.5 m from the floor). Participants performed 2 repetitions for each test with 1 minute of rest between repetitions, with the exception of the
maximum static lift test (one repetition). Besides, there was a resting period of 3 min among tests while recovery was identical in the two experimental trials. The best score of each test was used for the statistical analysis. These same tests, maintaining the order and recovery were performed after each combat to assess the muscle fatigue induced by the fights (Figure 1). After the end of the performance measurements, participants were required to fill out a questionnaire about their rate of perceived exertion during the tests. This questionnaire included a 1-10 point scale, and participants were previously informed that 1 point meant a minimal amount and 10 points meant a maximal amount of the item.

**Statistical analysis**

Data were collected as previously indicated and the results of each test were blindly introduced into the statistical package SPSS v 19.0 and analyzed. The normality of each variable was initially tested with the Shapiro-Wilk test. All the continuous variables included in this research presented a normal distribution ($P > 0.05$). Within-group (pre, post-1 and post-2 fight) and between-group (caffeine vs. placebo) comparisons were performed using a two-way (time x group) analysis of variance (ANOVA) with repeated measures. After a significant F-test (Geisser-Greenhouse correction for the assumption of sphericity), differences between means were identified using the Bonferroni adjustment. The effect size was calculated in all pair-wise comparisons according to the formula proposed by Glass, et al. 22. The magnitude of the effect size was interpreted using the scale of Cohen 23: an effect size lower than 0.2 was considered small, an effect size around 0.5 was considered medium and an effect size over 0.8 was considered large. The significance level was set at $P < 0.05$. Data are presented as mean ± standard deviation.
RESULTS

Actions during combats

In comparison to the placebo, the number of high-intensity offensive actions (duration and blocks) was greater with the ingestion of the caffeine in combat 1 (duration: \( P = 0.02, d = 1.2 \); blocks: \( P < 0.01, d = 1.4 \)) and combat 2 (duration: \( P = 0.01, d = 0.5 \); blocks: \( P = 0.04, d = 0.5 \)). In the caffeine trial successful offensive actions were greater in combat 2 (\( P = 0.02, d = 0.6 \)). No significant differences were found in high-intensity defensive or in neutral actions between caffeine and the placebo (Table 1). There were no significant differences between combat 1 and combat 2 in any of the variables analyzed.

Blood lactate concentration

There were no significant differences in blood lactate concentration between placebo and caffeine trials in the pre-competition (placebo: \( 3.1 \pm 1.2 \text{ mmol} \cdot \text{L}^{-1} \), \( P = 0.33 \)) and post-fight 1 (\( 13.3 \pm 3.9 \text{ mmol} \cdot \text{L}^{-1}, P = 0.09 \)) measurements. On the other hand, blood lactate concentration was higher in the caffeine trial than the placebo trial in the pre-fight 2 measurement (\( 7.5 \pm 2.7 \text{ mmol} \cdot \text{L}^{-1}, P = 0.01, d = 0.5 \)) and just after the second fight (\( 13.6 \pm 4.0 \text{ mmol} \cdot \text{L}^{-1}, P = 0.02, d = 0.5 \); Figure 2).

Handgrip strength, maximum static lift, and height in countermovement jump

In comparison to the placebo, the ingestion of caffeine enhanced handgrip strength before the competition for the dominant (\( 4.4 \pm 6.3 \% , P = 0.01, d = 0.8 \)) and non-dominant hand (\( 4.9 \pm 7.2 \% , P = 0.02, d = 0.4 \)). The decrease in handgrip strength was significantly higher in the caffeine trial than in the placebo trial from pre-competition to post-fight 1 and 2 in both hands (\( P < 0.05 \); Figure 3).

In comparison to the placebo, the ingestion of caffeine increased performance in the maximal static lift test in the pre-competition measurement by \( 15.8 \pm 17.0 \% (P < 0.01, d = \)
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0.5) and in the post-fight 1 by 17.8 ± 30.6 % (P < 0.01, d = 0.5). The decrease in the maximal static lift test with caffeine intake was higher than with the placebo from pre-competition to post-fight 2 and from post-fight 1 to post-fight 2 (P<0.05; Figure 2). Jump height in the countermovement jump was increased with the ingestion of the caffeine by 3.7 ± 3.7 %, (P = 0.02, d = 0.2) in the pre-competition measurement while no differences were found between pre-competition and post-fight 1 and post-fight 2 in the countermovement jump height (Figure 3). The ingestion of caffeine increased the rate of perceived exertion (6.2 ± 1.2 vs. 6.5 ± 1.8 points, P = 0.02, d = 0.3).

Peak power in the bench press exercise

The results for maximal power and maximal velocity during the propulsive phase of the bench press exercise are shown in Figure 4. In comparison to the placebo, maximal propulsive power was higher with the caffeine ingestion in the measurements performed pre-competition (caffeine: 902 ± 129 vs. placebo: 850 ± 136 W, P = 0.04, d = 0.4) and post-fight 1 (847 ± 143 vs. 783 ± 143 W, P = 0.02, d = 0.4). Moreover, in the caffeine trial, maximal propulsive power was significantly decreased between pre-competition and post-fight 2 by -13.2 ± 7.7 % (P = 0.00, d = 1.1; Figure 4). In comparison to the placebo, the ingestion of caffeine increased maximal propulsive velocity in pre-competition (caffeine: 1.76 ± 0.45 vs. placebo: 1.67 ± 0.48 m·s⁻¹, P = 0.03, d = 0.2), post-fight 1 (1.67 ± 0.47 vs. 1.55 ± 0.49 m·s⁻¹, P = 0.02, d = 0.3) and post-fight 2 (1.69 ± 0.44 vs. 1.52 ± 0.51 m·s⁻¹, P = 0.01, d = 0.4; Figure 4).

DISCUSSION

The use of caffeine is widespread among combat sports athletes but there is no reliable information to determine whether this substance might be beneficial for sports that combine high values of strength applied in an intermittent manner with complex technical
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and tactical skills. Thus the objective of this investigation was to determine the effectiveness of ingesting a moderate dose of caffeine (3 mg per kg of body mass) to enhance overall performance during a simulated Brazilian Jiu-jitsu competition. The main findings of this study indicate that the pre-exercise ingestion of caffeine: (1) increased the duration and the number of high intensity offensive actions during two simulated combats, corroborated by significantly higher blood lactate values and higher rates of perceived fatigue when compared to the ingestion of a placebo substance (Table 1 and Figure 2; $P < 0.05$); (2) increased performance in all specific physical tests measured prior to the onset of the competition (e.g. maximal isometric force production, maximal power output in upper and lower body, and specific gripping muscle endurance; Figures 3 and 4) with some physical improvements remaining after the first combat (e.g. maximal power in upper limbs and gripping muscle endurance; (3) specific physical tests measured just after the second combat could also confirm the higher intensity level of the athletes during combats in the caffeine trial, because significant reductions in grip capability (e.g. maximal isometric force in forearms and gripping endurance) and maximal power in upper limbs were observed in relation to the placebo. These results suggest that caffeine might be considered as an ergogenic aid for improving several aspects of Brazilian Jiu-Jitsu performance.

The video analysis of the two combats in the Brazilian Jiu-Jitsu simulated competition revealed increases both in the duration and the number of offensive high-intensity actions with the ingestion of caffeine and also more successful actions in combat 2 in comparison with combat 1. This rise in high-intensity actions was related to a tendency for an increased number of advantages, scoring actions and submissions with caffeine, as reflected in Table 1.

Lopes-Silva, et al. suggested that caffeine consumption does not increase performance during a high-intensity intermittent judo-specific test. However, Santos, et al. observed that caffeine enabled maintenance of intensity during two successive combats in taekwondo, and
increased the number of attacks/offensive actions in the second combat compared with a placebo. An explanation of the increase in only the high intensity offensive actions in the present investigation could be linked to enhanced anxiety arousal, vigor, impulsiveness and risk-taking found after the ingestion of caffeine. Moreover, the same dose (~3 mg·kg⁻¹) of caffeine increased the testosterone concentration by ~ 12% and this hormone is associated with an increase in risk-taking behaviors and aggressiveness. Further research on this “extra effect” of caffeine in combat sports could be interesting, because increased activation and intensity in competitions and training could be a key factor for success in grappling sports.

The longer duration and higher intensity actions during the fights were accompanied by significantly higher lactate values before and after combat 2 (Figure 2). The link between caffeine ingestion and increased blood lactate levels after intermittent exercise is contradictory. While some studies have shown that caffeine intake (6 mg·kg⁻¹) did not alter either blood lactate concentration or athletic performance during repeated bouts of short-term, high intensity exercise, others have reported elevated blood lactate levels concomitant with caffeine ingestion (5-6 mg·kg⁻¹; ) with no change in performance. Besides, other investigations have shown increased blood lactate concentrations and benefits for performance in multiple sprint ability after caffeine (5-6 mg·kg⁻¹). In spite of discrepancies in the outcomes of the investigations mentioned above, we suggest that caffeine might increase the athletes’ intensity during combats and thus, a higher blood lactate concentration is a direct consequence of increased glycolytic anaerobic metabolism.

In relation to the specific physical tests applied at three particular moments in the investigation (see Figure 1 for details), all of them showed improvements on pre-competition values with the ingestion of caffeine. Respecting maximal force production, it increased in both hands (Figure 3). In previous studies with a similar dose of caffeine (3 mg·kg⁻¹),
significant improvements have been reported in hand grip force in tennis and volleyball players.\textsuperscript{16,17} As for muscular endurance actions, the ingestion of caffeine improved permanence time in a specific strength endurance test (e.g. Maximum static lift; Figure 3), a key variable for grappling sports.\textsuperscript{21,29} Another interesting result from this study was significantly increased maximal power output in the bench press (Figure 4) and enhanced jump height. These findings are consistent with some investigations that have found that doses of 3 mg · kg\textsuperscript{-1} are enough to enhance maximal power output with similar loads to that used in the present investigation in bench press \textsuperscript{11,12} and with several studies that show increases in jump height in various sports with the same doses of caffeine.\textsuperscript{10,16}

Regarding the measurements performed after the first combat, caffeine-induced improvements remained in the maximum static lift test, and maximal power in the bench press exercise. In relation to gripping endurance, a meta-analysis found that caffeine improved muscular endurance by ~18\% in studies in which a submaximal isometric force was maintained until volitional fatigue.\textsuperscript{13} Another important finding was the maintenance of power in the upper limbs, because the decisive movements/actions that determine the result of the fight in several grappling sports like BJJ, Wrestling and Judo, are based on power muscle contractions \textsuperscript{14,15,29} and the capacity to repeat these power actions with muscular fatigue.\textsuperscript{30}

Lastly in relation to the physical tests measured at the end of the second fight, caffeine significantly reduced gripping endurance, force production in both hands and maximal power in the bench press while these reductions were less evident in the placebo trial. It seems apparent that these decreases support the idea, together with the increases in offensive actions and blood lactate, that caffeine ingestion increases the intensity of combats. However, despite the reductions, when compared with the previous measurements in the caffeine trial, the values obtained in these physical tests were not lower than the ones obtained during the
placebo trial (Figure 3 and 4). Besides in caffeine trial, the number of successful actions in
the second combat, which involved a higher score according to the official rules, was
increased. Therefore, it seems that the consumption of a moderate dose of caffeine might
augment the duration and number of the offensive high intensity actions and the athletes'
performance during successive combats without causing significant fatigue.

**PRACTICAL APPLICATIONS:**

Moderate caffeine supplementation could be considered by coaches of combat sports
for enhancing the intensity of training sessions and achieving success during official
competitions in which athletes have to perform successive bouts with limited rest.
Furthermore the use of caffeinated supplements can help to increase and maintain specific
skills in grappling sports during several combats, such as the ability to sustain high levels of
muscle power in the upper limbs and the capacity of the muscles responsible for the grip on
the gi (e.g. uniform) to perform maximal or submaximal contractions for an extended period
of time. All this information suggest that pre-combat caffeine ingestion can increase the
likelihood of obtaining a victory during a BJJ competition.

**CONCLUSIONS**

The ingestion of 3 mg of caffeine per kg of body mass enhanced the intensity of
combat and aided to keep muscular power production and gripping endurance during two BJJ
simulated combats. The ingestion of caffeine involved a minimal but significant increase in
the ratings of perceived exertion although the increased fatigue did not diminish performance
in simulated competition. Thus, it is reasonable to conclude that caffeine might be an
ergogenic nutritional supplement for improving physical performance in elite BJJ athletes.
ACKNOWLEDGMENTS

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Conflict of Interest

All the authors declare that they have no conflict of interest derived from the outcomes of this study.

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REFERENCES


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Figure 1: Experimental design.

Figure 2: Blood lactate concentration in a simulated Brazilian Jiu-Jitsu competition with the ingestion of 3 mg·kg⁻¹ of caffeine or a placebo (0 mg·kg⁻¹). Data are mean ± SD for 14 participants. * = caffeine different from placebo (P < 0.05).
**Figure 3**: Maximum static lift permanence, height in countermovement jump and handgrip force, before and after a simulated Brazilian Jiu-Jitsu competition with the ingestion of 3 mg·kg⁻¹ of caffeine or a placebo (0 mg·kg⁻¹). Data are mean ± SD for 14 participants. * = caffeine different from placebo (P < 0.05). # different from pre-competition (P < 0.05); § different from post-fight 1 (P < 0.05).
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**Figure 4:** Maximal power and velocity during the propulsive phase of a bench-press exercise before and after a simulated Brazilian Jiu-Jitsu competition with the ingestion of 3 mg·kg⁻¹ of caffeine or a placebo (0 mg·kg⁻¹). Data are mean ± SD for 14 participants. * = caffeine different from placebo (P < 0.05). # post-fight 2 different from pre-competition (P < 0.05).
**Table 1:** Successful offensive actions (submissions, scoring actions and advantages) and time structure (high and neutral intensity actions) in two successive simulated combats during a simulated Brazilian Jiu-Jitsu competition with the ingestion of 3 mg·kg\(^{-1}\) of caffeine or a placebo (0 mg·kg\(^{-1}\)). Data are mean ± SD for 14 participants. * = caffeine different from placebo (\(P < 0.05\)).

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<th>PLACEBO</th>
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<td><strong>Successful offensive actions</strong></td>
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<tr>
<td>Combat 1</td>
<td>2.4 ± 2.8</td>
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<td>Combat 2</td>
<td>4.2 ± 4.6</td>
<td>5.4 ± 5.1 *</td>
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<td><strong>Submissions</strong></td>
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<td>0.1 ± 0.4</td>
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<td>Combat 2</td>
<td>0.6 ± 0.9</td>
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<td><strong>Scoring actions</strong></td>
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<td>Combat 1</td>
<td>1.6 ± 2.6</td>
<td>1.7 ± 2.0</td>
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<td>Combat 2</td>
<td>2.9 ± 4.0</td>
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<td><strong>Advantages</strong></td>
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<td>Combat 1</td>
<td>0.7 ± 0.7</td>
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<td>Combat 2</td>
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<td><strong>Duration of high-intensity offensive actions (s)</strong></td>
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<tr>
<td>Combat 1</td>
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<td>Combat 2</td>
<td>30.7 ± 24.0</td>
<td>43.6 ± 27.3 *</td>
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<td><strong>High-intensity offensive actions (blocks)</strong></td>
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<td>6.3 ± 2.9</td>
<td>10.5 ± 5.0 *</td>
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<td>Combat 2</td>
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<tr>
<td>Combat 1</td>
<td>366.7 ± 91.1</td>
<td>379.8 ± 58.1</td>
</tr>
<tr>
<td>Combat 2</td>
<td>343.8 ± 72.5</td>
<td>349.9 ± 56.6</td>
</tr>
<tr>
<td><strong>Neutral actions (blocks)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combat 1</td>
<td>9.2 ± 1.5</td>
<td>11.2 ± 2.8</td>
</tr>
<tr>
<td>Combat 2</td>
<td>11.0 ± 3.1</td>
<td>12.5 ± 4.4</td>
</tr>
</tbody>
</table>