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**Original Article**

# Judo approach and handgrip analysis: determining aspects of world circuit high performance

LINDSEI BRABEC MOTA BARRETO[1]; FÁBIO DAL BELLO[2]; RAFAEL ANDRE ARAUJO[3]; CIRO JOSÉ BRITO[4] JOSÉ RAIMUNDO FERNANDES[5]; BIANCA MIARKA[6]
[1,4,5,6,] Federal University of Juiz de Fora, Campus Governador Valadares, BRAZIL.
[2] Head of Physical Activity and Sports Science Master Program. Universidad Santo Tomás, Santiago, CHILE.
[3]Unideal, Brasilia, BRAZIL.
[6] Federal University of Rio de Janeiro, Rio de Janeiro, BRAZIL.

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**Abstract**
In judo, the moments of approach and gripping are relevant for defining the next actions of athletes. In understanding these action phases, the coach can plan the training according to the specific patterns of each weight division. Therefore, this study analyzed the time spent in approach and in performance of different types of gripping by athletes in all male weight divisions in world judo matches. For this, we analyzed 548 combats, with time-motion analysis performed through a previously-validated protocol. The main results indicate a significant effect, in which lighter athletes are more differentiated in the approach and in the gripping types, and heavier athletes spent more time on gripping phase with more defensive grips. There was a significant correlation between anteroposterior positioning of the right and left foot ($p \leq 0.05$) with the all gripping attempts, except right sleeve, left dorsal, left and right sleeve, right dorsal and right sleeve, and left dorsal and left sleeve. In conclusion, our results can be applied to planning and prescribing specific training for the different weight divisions, taking into account the specific frequencies obtained in these combat phases.
**Keywords**: Martial arts, time motion studies, athletic performance, task performance and analysis.

## Introduction

In recent years, research has shown that understanding the technical-tactical interactions arising from the judo context can help coaches develop more specific training for competitive results. Judo combat can be divided into temporal phases, and among them there is the approach and gripping phase, which are of crucial importance in defining the fighter's next actions (Brito, Gomes Moreira, et al., 2017; Brito, Miarka, de Durana, & Fukuda, 2017; Miarka et al., 2018). The handgrip domain enables higher control and induces imbalance in the opponent (kuzushi) by pushing or pulling, facilitating application of the technique and positioning the opponent for the subsequent phases of the attack (Miarka et al., 2012). In this line, studies have shown that high-level judokas are characterized by the ability to disrupt the gripping of their opponent and to quickly perform their own, as well as having the ability to perform gripping from the opposite side of their opponent or even the dominant laterality itself. This opposite body position to that performed by the opponent (kenka-yotsu) is often adopted with defensive objectives, given that the athlete needs to make changes in his actions constantly in order to diminish the opponent's possibility to react (Calmet, Miarka, & Franchini, 2010; Miarka et al., 2012).

Miarka et al. (2012) demonstrated that the approach time without gripping in senior women (52±48s) was higher than in the pre-juvenile (42±40s), juvenile (40±29s) and junior (31±26s). Calmet et al. (2010) presented significant differences between 9 beginners, 16 black belts and 10 high-performance athletes at the time of approach (17±13s, 18±11s and 35±32s; respectively) in attempt to avoid gripping (4±3s, 9±11s and 21±28s; respectively) and in attempt to make gripping contact (1±3s, 10 9s and 35±42s; respectively). These studies showed that higher competition level and age increase the time spent in gripping disputes. Furthermore, the chance of winning increases when the athlete either holds the judogi before their opponent and carries out a more efficient handgrip to apply the attack, or avoids their opponent's gripping after having scored.

Published studies currently address the importance of the approach and gripping phases for high performance by athletes. However, there is a lack of studies which have investigated the temporal analysis of these phases in all the weight divisions. Understanding the specificities of approach and gripping phases according to each weight division can induce modifications and adjustments to the training load and to the planned tactical actions. Therefore, the present study analyzed the time spent in the approach and the types of gripping performed by athletes in all seven male weight divisions of the world judo circuit.


Corresponding Author: CIRO JOSÉ BRITO, E-mail: cirojbrito@gmail.com

## Materials and methods

*Experimental approach*

This is a transversal and descriptive study using a time-motion analysis protocol in order to characterize the phases of approach and achievement of handgripping in world circuit competitions in all male weight divisions, according to previously defined protocols (Miarka et al., 2018; Miarka, Del Vecchio, et al., 2016; Miarka, Fukuda, Del Vecchio, & Franchini, 2016).

*Sample*

The sample was composed by 548 analyzes of combats performed by male athletes classified for the 2012 London Olympic Games in all seven weight divisions (Extra-lightweight: n=44; Half-lightweight: n=132; Lightweight: n=71; Half-middleweight: n=152; Middleweight: n=42, Half-heavyweight: n=35 and Heavyweight: n=72). In order to ensure ecological validity and check the elite status of the sample, all combats were analyzed using several publicly available judo video databases, including those provided by the International Judo Federation and the International Olympic Committee. Each video had to be of sufficient quality (standard definition 480/60i) to be included and taken from a landscape view of the entire competition area. The entire sample was extracted by competitions promoted by the International Judo Federation (IJF) in 2011-12: Olympic Games (London, 2012), World Championships (Paris, 2011), five Grand Slams (Paris, 2011 and 2012; Tokyo, 2011; Rio de Janeiro, 2011 and Moscow, 2011), six Grand Prix (Düsseldorf, 2011 and 2012; Qingdao, 2011; Amsterdam, 2011; Abu Dhabi, 2011), and 19 World Cups (Prague, 2012 and 2011; Oberwart, 2012 and 2011; Bucharest, 2012 and 2011; Jeju, 2012; Madrid, 2012 and 2011; Tbilisi, 2012 and 2011; Warsaw, 2011; Tallinn, 2012; Miami, 2012; San Salvador, 2012; Apia, 2012; Buenos Aires, 2012; Lisbon, 2012; and Sofia, 2012). The free computer version of VirtualDub Program 1.8.6 was used to fragment and edit images, and Frami® software was used to conduct time-motion analysis; the study was previously approved by the Ethics and Local Research Committee (protocol 1052010).

*Judo time-motion combat analysis*

The approximation and handgrip phases were observed according to the frequency of occurrences and their time following the previous protocol and all analyzes were done using Frami software (Miarka et al., 2018; Miarka, Del Vecchio, et al., 2016; Miarka, Fukuda, Del Vecchio, et al., 2016; Miarka, Fukuda, Heinisch, et al., 2016). In the approach phase, the following motions patterns divided into left and right were analyzed: circular motions, foot in anteroposterior position, lateral steps and handgrip attempt (Calmet et al., 2010; Courel, Franchini, Femia, Stankovic, & Escobar-Molina, 2014). In the handgrip phase, the following gripping types were analyzed from the placement of the hands on the opponent's judogi and the sagittal plane was used to define the right and left sides: handgrip on the collar, handgrip on the sleeve, handgrip on the dorsal region, and their combinations (Calmet et al., 2010; Courel et al., 2014; Miarka et al., 2014).

In order to verify possible differences between intra and inter-expert measurement of the protocol variables, comparisons of all variables were carried out by the Mann-Whitney U-Test, and no differences were observed among intra and inter-expert. In addition, the correlation between measurements obtained for each model was verified by means of the Cohen Kappa coefficient (Miarka, Del Vecchio, et al., 2016; Miarka, Fukuda, Del Vecchio, et al., 2016; Miarka, Fukuda, Heinisch, et al., 2016) with an inter-agreement range between 0.45 and 1.00, classification of "Almost perfect" for all variables, and with a range between 0.82 and 1.00 for intra-expert analysis, along with a classification of "Almost perfect" for all ten variables. The significance level of $p \leq 0.05$ was used.

*Statistical analysis*

All statistical tests were processed using SPSS software (version 20.0; SPSS, Inc., Chicago, IL, USA). Descriptive data are presented as mean and standard deviation (SD). The Kolmogorov-Smirnov test (K-S) was used to determine the normal distribution of the data. Time-motion comparisons between weight divisions were performed by one-way ANOVA followed by Bonferroni *post hoc* to verify the differences between weight divisions (Extra-lightweight vs. Half-lightweight vs. Lightweight vs. Half-middleweight vs. Middleweight vs. Half-heavyweight vs. Heavyweight). For analysis of variance, Eta squared ($\eta 2$) values were calculated to evaluate effect size and interpreted using the criteria: strong effect size ($\eta 2>0.14$), moderate effect size ($0.06<\eta 2<0.14$) and weak effect size ($\eta 2<0.06$). The 95% confidence intervals were calculated and a significance level of $P \leq 0.05$ was used for all analyses.

## Results

The mean total fighting time was 304.8±169.6 s, the approach was 109.1±79.1 s, and handgrip time was 124.6±100.1 s. Table 1 shows the total time used in the approach and handgrip phases separated by weight category.

**Table 1.** Mean and standard deviation of the total time used in the approach and gripping phases.

| Weight division | Approach Time (s) | Handgrip Time (s) |
|---|---|---|
| Extra-lightweight | 83.8±71.5 | 60.4±52.3[b] |
| Half-lightweight | 115.3±85.9 | 104.5±75.9[c] |
| Lightweight | 137.5±86.2[a] | 125.9±95.8 |
| Half-middleweight | 96.5±57.6 | 142.2±102.2 |
| Middleweight | 117.7±81.5 | 104.9±110.6 |
| Half-heavyweight | 111.5±72.7 | 150.9±112.6 |
| Heavyweight | 102.7±73.8 | 165.2±119.6[d] |

Notes: The values presented are mean (μ) and standard deviation (SD); [a] different from Half-middleweight (p=0.05) and Extra-lightweight (p=0.007); [b] different from the categories Lightweight (p=0.009), Half-middleweight, Half-heavyweight and Heavyweight (p≤0.001 for the last three comparisons); [c] different from the categories Half-middleweight (p=0.033) and Heavyweight (p≤0.001); [d] different from Middleweight (p=0.022).

There was an effect of the category on the total approach time (F=2.82, p=0.01, $ç^2$=0.037), and the category Lightweight spent a higher timer in this phase when compared to the Half-middleweight (p=0.05) and Extra-lightweight (p=0.007). In relation to the total time of handgrip in combat, the results showed a category effect for this variable (F=7.7, p≤0.001, $ç^2$=0.084), with lower time for Extra-lightweight category when compared with the Lightweight (p=0.009), Half-middleweight (p≤0.001), Half-heavyweight (p≤0.001) and Heavyweight (p≤0.001) categories. The Half-lightweight category also presented a lower time when compared to the Half-middleweight (p=0.033) and Heavyweight (p≤0.001) categories. In turn, the Heavyweight category showed a longer handgrip time when compared to the Middleweight category (p=0.022). Table 2 presents the descriptive data of the time in each type of approach.

**Table 2.** Time of the main types of approach in combat of the world judo circuit, separated by weight division.

| **Weight division** | **Circular to left (s)** | **Circular to right (s)** | **Anteroposterior left (s)** | **Anteroposterior right (s)** | **Attempt of gripping (s)** |
|---|---|---|---|---|---|
| Extra-lightweight | 0.5±1.3 | 0.1±0.3 | 4.0±4.9 | 3.2±3.6 | 39.3±40.6 |
| Half-lightweight | 0.7±1.1 | 0.5±1.6 | 5.1±5.5 | 3.9±5.3 | 66.2±62.4 |
| Lightweight | 0.4±1.0 | 0.3±0.9 | 7.8±7.4[b] | 3.2±5.6 | 77.3±65.3[f] |
| Half-middleweight | 1.7±3.6[a] | 0.5±1.1 | 3.8±5.1 | 6.3±6.3[d] | 14.1±38.6[e] |
| Middleweight | 0.5±0.8 | 0.8±2.0 | 3.6±5.0 | 6.1±5.8 | 55.0±55.2 |
| Half-heavyweight | 0.2±0.5 | 0.1±0.3 | 7.3±6.6[c] | 3.4±5.0 | 59.7±52.1 |
| Heavyweight | 0.7±1.5 | 0.3±0.9 | 2.6±4.4 | 5.2±4.9 | 50.1±54.7 |

Notes: The values presented are mean (μ) and standard deviation (SD); [a] different from Extra-lightweight (p=0.015), Half-lightweight (p≤0.001), Lightweight (p ≤ 0.001), Middleweight (p=0.014), Half-heavyweight (p=0.004) and Heavyweight (p=0.021); [b] different from the categories Extra-lightweight (p=0.007), Half-lightweight (p=0.018), Half-middleweight (p≤0.001), Middleweight (p=0.002), and Heavyweight (p≤0.001); [c] different from the categories Half-middleweight (p=0.012), Middleweight (p=0.049) and Heavyweight (p≤0.001); [d] different from the categories Extra-lightweight (p=0.018), Half-lightweight (p=0.005) and Lightweight (p=0.002); [e] different from the categories Half-lightweight (p≤0.001), Lightweight (p≤0.001), Middleweight (p=0.003), Half-heavyweight (p=0.002) and Heavyweight (p=0.002); [f] different from the categories Heavyweight (p=0.041) and Extra-lightweight (p=0.005).

There was a difference (F=5.67, p≤0.001, $ç^2$=0.059) between the divisions for the right-to-left circular movement, being that the Half-middleweight uses a longer time of this action when compared to the Extra-lightweight (p=0.015), Half-lightweight (p≤0.001), Lightweight (p≤0.001), Middleweight (p=0.014), Half-heavyweight (p=0.004) and Heavyweight (p=0.021) categories. No differences were observed between the groups for the circular movement time from left to right. For the approach, a significative effect was observed for the anteroposterior position with the left foot (F=8.06, p≤0.001, $ç^2$=0.082), where the Lightweight group used this position for a longer time than the Extra-lightweights (p=0.007), Half-lightweights (p=0.018), Half-middleweights (p≤0.001), Middleweights (p=0.002) and Heavyweights (p≤0.001). Half-heavyweight also presented a lower time of this approach when compared to the Half-middleweight (p=0.012), Middleweight (p=0.049) and Heavyweight (p≤0.001) categories. Regarding the anteroposterior combat position with the right foot at the front, a difference was observed between the divisions (F=4.95, p≤0.001, $ç^2$=0.052), as the Half-middleweight showed a longer time than Extra-lightweight (p=0.018), Half-lightweight (p=0.005) and Lightweight (p=0.002). For the attempted gripping time, there was an effect of the division (F=13.53; p≤0.001; $ç^2$=0.131) with a lower time by the Half-middleweight category when compared with the Half-lightweight (p≤0.001), Lightweight (p=0.001), Middleweight (p=0.003), Half-heavyweight (p=0.002) and Heavyweight (p=0.002). In addition, the Lightweight division showed significantly longer gripping time than Heavyweight (p=0.041) and Extra-lightweight (p=0.005). Table 3 shows the descriptive data of the time in each type of handgrip.

**Table 3.** Time in configurations of gripping separated by weight division.

| Weight division | Left collar (s) | Right collar (s) | Left sleeve (s) | Right sleeve (s) |
|---|---|---|---|---|
| Extra-lightweight | 1.5±2.1 | 0.8±1.4[d] | 0.5±1.0 | 0.4±0.7 |
| Half-lightweight | 1.7±2.4 | 1.6±2.3 | 1.3±2.3 | 0.8±1.4 |
| Lightweight | 1.7±2.3 | 1.7±2.0 | 1.2±2.2 | 1.0±1.6 |
| Half-middleweight | 2.8±4.0 | 3.2±3.9[b] | 1.0±1.4 | 1.6±2.5[e] |
| Middleweight | 2.9±4.0 | 2.9±4.2 | 0.5±0.9 | 0.5±0.9 |
| Half-heavyweight | 1.1±1.5 | 3.9±3.6[c] | 1.6±2.4 | 0.7±1.1 |
| Heavyweight | 3.1±3.8[a] | 2.0±2.9 | 0.7±1.2 | 0.9±1.4 |
| **Weight division** | **Left sleeve Right sleeve (s)** | **Left collar Right collar (s)** | **Left collar Right sleeve (s)** | **Right collar Left sleeve (s)** |
| Extra-lightweight | 1.2±1.5 | 0.2±0.5 | 2.0±3.2 | 1.5±2.4 |
| Half-lightweight | 2.3±2.3 | 0.4±1.2 | 2.0±3.7 | 2.1±2.6 |
| Lightweight | 2.7±3.0[i] | 0.7±1.4 | 2.0±2.5 | 2.5±3.1 |
| Half-middleweight | 2.3±2.8 | 0.9±1.7 | 3.8±4.6 [k] | 2.2±3.4 |
| Middleweight | 0.9±1.5[g] | 1.4±2.5 | 2.9±4.4 | 1.8±3.6 |
| Half-heavyweight | 1.5±2.3 | 1.6±1.7 | 1.5±2.3 | 3.9±4.2[l] |
| Heavyweight | 0.9±1.6[h] | 4.7±8.4[j] | 3.3±4.1 | 1.2±2.0 |
| **Weight division** | **Left dorsal (s)** | **Left dorsal Left sleeve (s)** | **Right collar Right sleeve (s)** | **Left collar Left sleeve (s)** |
| Extra-lightweight | 0.0±0.2 | 0.1±0.4 | 0.0±0.2 | 2.0±3.2 |
| Half-lightweight | 0.1±0.4 | 0.6±1.3 | 0.0±0.1 | 2.0±3.7 |
| Lightweight | 0.2±0.5 | 0.2±0.6 | 0.1±0.4 | 2.0±2.5 |
| Half-middleweight | 0.2±0.8 | 1.0±1.9[n] | 0.2±0.7[p] | 3.8±4.6 [q] |
| Middleweight | 0.7±1.6[f] | 2.8±4.2[m] | 0.1±0.3 | 2.9±4.4 |
| Half-heavyweight | 0.1±0.2 | 1.9±2.9[o] | 0.1±0.3 | 1.5±2.3 |
| Heavyweight | 0.2±0.8 | 1.0±1.6 | 0.0±0.1 | 3.3±4.1 |

Notes: The values presented are mean (ĕ) and standard deviation (SD); [a] different from Half-lightweight (p=0.047) and Half-heavyweight (p=0.035); [b] different from Lightweight (p=0.012) and Half-lightweight (p≤0.001); [c] different from Extra-lightweight (p=0.001), Half-lightweight (p=0.002), Lightweight (p=0.009) and Heavyweight (p=0.042); [d] different from Half-middleweight (p≤0.001), Middleweight (p=0.029) and Half-heavyweight (p≤0.001); [e] different from Extra-lightweight (p≤0.001), Half-lightweight (p≤0.001) and Middleweight (p=0.004); [f] different from Extra-lightweight (p≤0.001), Half-lightweight (p≤0.001), Lightweight (p=0.003), Half-middleweight (p≤0.001), Half-heavyweight (p=0.002) and Heavyweight (p=0.006); [g] different from Half-lightweight (p=0.021), Lightweight (p=0.004) and Half-middleweight (p=0.018); [h] different from Half-lightweight, Lightweight and Half-middleweight (p≤0.001 for the three comparisons); [i] different from Extra-lightweight (p=0.021); [j] different from other weight categories (p≤0.001 for all comparisons); [k] different from Half-lightweight (p=0.002), Lightweight (p=0.023) and Half-heavyweight (p=0.022); l different from Extra-lightweight (p=0.009), Half-lightweight (p=0.039), Half-middleweight (p=0.042), Middleweight (p=0.048) and Heavyweight (p≤0.001); [m] different from the other categories (p≤0.001 for all comparisons), except for Half-heavyweight; [n] different from Lightweight (p=0.041); [o] different from Extra-lightweight (p≤0.001), Half-lightweight (p=0.006) and Lightweight (p≤0.001); [p] different from Heavyweight (p=0.009) and Half-lightweight (p≤0.001); [q] different from Half-lightweight (p=0.002), Lightweight (p=0.023) and Half-heavyweight (p=0.022).

There was a difference (F=4.23, p≤0.001, ç$^2$=0.045) between the divisions when compared to the time in which the athletes performed the gripping on the left collar; the Heavyweight category spent more time in this action in comparison to the Half-lightweight (p=0.047) and Half-heavyweight (p=0.035). In addition, a significant effect was observed on the right collar (F=7.32, p≤0.001, ç$^2$=0.075), with the Half-heavyweight having a longer time in comparison to the Extra-lightweight (p≤0.001), Half-lightweight (p=0.002), Lightweight (p=0.009) and Heavyweight (p=0.042) divisions. The athletes in the Extra-lightweight division showed a lower time than Half-middleweight (p≤0.001), Middleweight (p=0.029) and Half-heavyweight (p≤0.001). On the other hand, the Half-middleweight division also performed longer handgrip time on the right collar when compared with the Lightweight (p=0.012) and Half-lightweight (p≤0.001) groups. There was a statistically significant difference (F=5.24, p≤0.001, ç$^2$=0.055) for the right sleeve gripping time, with longer time for the Half-middleweight when compared to the Extra-lightweight (p≤0.001), Half-lightweight (p≤0.001) and Middleweight (p=0.004) categories. In addition, for the left dorsal gripping comparisons (F=4.19, p≤0.001, ç$^2$=0.045), the Middleweight division showed differences from the Extra-lightweight (p≤0.001), Half-lightweight (p≤0.001), Lightweight (p=0.003), Half-middleweight (p≤0.001), Half-heavyweight (p=0.002) and Heavyweight (p=0.006). Furthermore, the right dorsal gripping had an overall mean of 0.1±0.03 s, without statistical differences (p>0.05).

There was also a difference (F=6.78, p≤0.001, ç$^2$=0.07) for left and right sleeve gripping, where the Middleweight category performed a lower time than the Half-lightweight (p=0.021), Lightweight (p=0.004) and

Half-middleweight (p=0.018). The Heavyweight division also presented a lower time on the left sleeve and right sleeve when compared to the Half-lightweight, Lightweight and Half-middleweight (p≤0.001 for the three comparisons). On the other hand, the Lightweight spent more time than the Extra-lightweight (p=0.021) group. There were differences for the right collar and left collar gripping (F=15.32, p≤0.001, $ç^2$=0.146) with longer gripping time for Heavyweight division when compared with the others (p≤0.001 for all comparisons). There was an effect for the left collar and right sleeve gripping (F=4.26, p≤0.001, $ç^2$=0.045) when comparing the Half-middleweight category with the Half-lightweight (p=0.002), Lightweight (p=0.023) and Half-heavyweight (p=0.022). There was an effect for right collar and left sleeve gripping (F=3.54, p=0.002, $ç^2$=0.038), where the Half-heavyweight division presented a longer time than the Extra-lightweight (p=0.009), Half-lightweight (p=0.039), Half-middleweight (p=0.042), Middleweight (p=0.048), and Heavyweight (p≤0.001) divisions. In addition, we observed significant effect for the left dorsal and right sleeve gripping (F=12.038; p≤0.001; $ç^2$=0.118), as the Middleweight category performed a longer time than others (p≤0.001 for all comparisons). The Half-middleweight group also performed a longer time in the left dorsal and right sleeve when compared to the Lightweight (p=0.041). Meanwhile, the Half-heavyweight division showed a longer time than the Extra-lightweight (p≤0.001), Half-lightweight (p=0.006) and Lightweight (p≤0.001) groups. In turn, statistical differences were observed for the right collar and right sleeve gripping (F=3.89, p≤0.001, $ç^2$=0.042). The Half-middleweight division demonstrated a longer time than the Heavyweight (p=0.009) and Half-lightweight (p≤0.001). Finally, there was a significant effect for the left collar and left sleeve (F=4.25, p≤0.001, $ç^2$=0.045). The Half-middleweight category performed a longer time than the Half-lightweightt (p=0.002), Lightweight (p=0.023) and Half-heavyweight (p=0.022). Table 4 presents the results of the Spearman correlation for the approach and gripping phase.

**Table 4.** Correlation between the approach and gripping phases carried out in combat.

| **Types of gripping** | **Actions in the Approach Phase (s)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | Circular to left | Circular to right | Anteroposterior left | Anteroposterior right | Right lateral steps | Left lateral steps | Gripping attempt |
| Left collar | 0.019 | 0.042 | -0.178** | 0.496** | 0.056 | 0.012 | 0.048 |
| Right collar | 0.109* | 0.016 | 0.383** | -0.126** | -0.041 | -0.065 | 0.037 |
| Left sleeve | 0.058 | 0.045 | 0.252** | 0.025 | 0.023 | -0.005 | 0.245** |
| Right sleeve | 0.114** | -0.006 | -0.012 | 0.175** | 0.059 | -0.051 | 0.078 |
| Left dorsal | 0.014 | 0.006 | -0.076 | 0.249** | 0.06 | -0.021 | 0.1* |
| Right dorsal | -0.055 | 0.046 | 0.265** | -0.237** | -0.048 | -0.019 | 0.112** |
| Left and right sleeve | 0.049 | 0.088* | 0.203** | 0.065 | -0.018 | -0.068 | 0.208** |
| Left collar and right collar | -0.12** | 0.106* | 0.127** | 0.12** | 0.102* | 0.005 | 0.032 |
| Right collar and left sleeve | -0.058 | 0.088* | 0.617** | -0.416** | -0.011 | -0.058 | 0.208** |
| Left collar and right sleeve | 0.146** | -0.018 | -0.418** | 0.677** | 0.082 | -0.039 | -0.024 |
| Left dorsal and left sleeve | -0.086* | 0.06 | 0.547** | -0.368** | -0.047 | -0.037 | 0.252** |
| Left dorsal and right sleeve | 0.017 | -0.009 | -0.196** | 0.406** | 0.019 | -0.041 | 0.068 |
| Right collar and right collar | 0.163** | -0.021 | -0.077 | 0.101* | 0.062 | 0.111** | -0.048 |
| Left collar and left sleeve | 0.147** | -0.022 | -0.415** | 0.678** | 0.082 | -0.067 | -0.024 |
| Right dorsal and right sleeve | 0.087* | 0.1* | -0.046 | 0.057 | 0.28** | -0.003 | 0.074 |
| Left dorsal and left sleeve | -0.054 | 0.034 | -0.037 | -0.082 | -0.012 | 0.814** | -0.048 |

Notes: **. Correlation with significance level of 0.01; *. Correlation with significance level of 0.05.

We observed significant correlations, classified as weak, for the right-to-left circular displacement action with the gripping configurations: i) on the right collar, ii) the right sleeve, iii) the left collar and the right sleeve, iv) the right collar and right sleeve, v) left collar and left sleeve, and vi) right dorsal and right sleeve. The right-to-left circular displacement action had negative correlations, classified as weak, with the gripping configurations: (i) left and right collars and (ii) right dorsal and left sleeve. On the other hand, the left to right circular movement also showed significant correlations, classified as weak, with the gripping configurations: i) left and right sleeve, ii) left and right collars, and iii) right collar and left sleeve. For the displacements

performed in anteroposterior position with the left foot in front, the Spearman analysis showed significant correlations, classified as moderate with: i) right collar, ii) right collar and left sleeve, and iii) right dorsal and left sleeve. Significant correlations were also observed, classified as weak, for gripping configurations: i) left sleeve, ii) right dorsal, iii) left and right sleeve, and iv) left and right collar. The statistical analysis also showed significant negative correlations, classified as moderate, for this same displacement between the antero-posterior position with the left foot forward and the gripping configurations: i) left collar and left sleeve and ii) left collar and right sleeve. There were significant and negative correlations, classified as weak, with the handgripping: i) left collar and ii) left dorsal and right sleeve.

Significant correlations were also observed between the antero-posterior position with the right foot in the front, classified as moderate, with the gripping configurations: i) left collar, ii) left collar and right sleeve, iii) left dorsal and right sleeve, and iv) left collar and left sleeve. Furthermore, correlations classified as weak occurred for antero-posterior displacement with the right foot forward with the: i) right sleeve, ii) left dorsal, iii) left and right collar, and vi) right collar and right sleeve. In contrast to the same type of displacement, there were significant negative correlations, classified as moderate with: i) right dorsal and left sleeve, and ii) right collar and left sleeve. Negative correlations were also observed, classified as weak, with handgripping of: i) right collar and ii) right dorsal. Significant correlations were observed for the displacements performed with lateral from left to right, classified as weak with the gripping configurations: i) right dorsal and right sleeve and ii) left collar and right collar. Likewise, significant correlations were observed for the lateral from the right to the left, one classified as weak with the right collar and right sleeve, and the other classified as strong with the left dorsal and left sleeve. In addition, significant correlations were observed, classified as weak, between the gripping attempt and types: (i) left sleeve, (ii) left dorsal, (iii) right dorsal, (iv) left sleeve and right sleeve, (v) right collar and left sleeve, and vi) right dorsal and left sleeve.

**Discussion**

In world-class judo combats, the details can make the difference for winning (Boguszewski, 2011; Brito, Miarka, et al., 2017; Calmet et al., 2010; Courel et al., 2014; Franchini, Sterkowicz, Meira, Gomes, & Tani, 2008). Technical-tactical analysis studies show that judokas tend to carry out an attack as soon as they hold the opponent's kimono (Calmet et al., 2010; Courel et al., 2014; Franchini et al., 2008). Thus, the approach and gripping are the first important steps to win a combat (Calmet et al., 2010; Courel et al., 2014). This study analyzed the time spent in the approach and the types of gripping performed by judokas in all seven male weight divisions competing on the world judo circuit. The main results indicated that lighter athletes were more differentiated in their approach and gripping types, and heavier athletes spent more time on gripping phase with a higher frequency of defensive grips. There was a significant correlation between anteroposterior positioning of the right and left foot with the all gripping attempts except right sleeve, left dorsal, left and right sleeve, right dorsal and right sleeve, and left dorsal and left sleeve. Our results can be used by coaches who want to compete on the world circuit and can establish specific strategies that differentiate their athletes and can anticipate the tactics established by their opponents.

Regarding the actions presented by the athletes in this approach phase, the Half-middleweight category presented a higher time of circular movement for the left and in antero-posterior with the right foot ahead when compared to the other weight categories. In the same way, the Lightweight category used the antero-posterior approach with the left foot forward and handgripping attempt for longer times than the Extra-lightweight and Heavyweight groups. These attempted gripping patterns should be considered by coaches to establish defense strategies and avoidance, since the approach and gripping position directs the type of attack that the judoka does next (Miarka et al., 2014; Miarka, Fukuda, Del Vecchio, et al., 2016). For the differences between the divisions, two possible situations are suggested here: 1) lighter athletes establish handgrips more quickly with subsequent technique or defense, and/or 2) perform a higher number of readjustments to hinder their opponent's gripping.

As for the gripping time, Heavyweight athletes establish this action for longer times than the others. In turn, with respect to the handgrip type, the Heavyweight category also demonstrates longer handgrip times on the right and left collar. An important strategy for athletes of this division is to anticipate the gripping, or to analyze the preferential techniques of their opponent to establish body positioning which enables them to counterattack. The Half-heavyweight category also had longer handgripping on the right collar when compared to other groups. Pierantozzi, Nerozzi, Piras, and Lubisco (2009) suggest that the use of handgrip on the reverse collar of the opponent (kenka yotsu) helps to block opposing attack actions, which is indicative of heavier athletes having a more defensive handgrip configuration than athletes of milder categories, who presented greater periods of using the left and/or right sleeve in different combinations.

It is assumed that with the prohibition of direct leg attacks and handgripping becoming a determinant variable to conduct attacks, athletes spend more time performing tactical readjustments in response to this phase of combat and interaction with their opponent (Courel et al., 2014). This assertion is reinforced by the longer period found in the approach phase, averaging 109.1±79.1s, which is a longer time than the finding in state competitions of 2008 of 59.7±49.6s (Miarka et al., 2012). This need to carry out an efficient handgrip can also be observed when the analysis is done by weight category, since the time spent in the approach phase is mostly used

in the gripping attempt in all weight divisions. In addition, the associations between the type of approach and the type of handgrip were mostly weak or moderate, demonstrating that the randomness of the handgrip and displacement may be directly linked to a higher competitive level and/or greater experience, since the accomplishment of these actions is able to reduce the capacity of the opponent to defend or to attack (Calmet et al., 2010).

**Conclusion**

Based on the aims and applied methods, we can conclude that the approach and handgrip phases make up a large part of the total combat time, and have become extremely important for competitive performance. Lighter athletes are the most differentiated because they spend more time in the approach phase making handgrip attempts, and when they perform they employ greater gripping diversity, while the heavier categories use a longer time in the handgrip phase with more defensive grips. The present findings demonstrate the importance of characterizing the approach and gripping phases of international athletes to help in modulating training actions. Understanding how each male division behaves can help in planning better contextualization of the training from the competitive situation.

**Conflict of interest**

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this manuscript.

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