

## Evolution of the temporal structure of world high competition judo combat (2013 a 2017)

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### Abstract

Judo is a sport that is constantly evolving. Rule modifications and changes in tactical strategies have enhanced scoring opportunities and reduced penalties. This study analyzed the evolution of the temporal structure of combat through an assessment of the total match time (TMT), time engaged in combat (CT), time without (TWOG) and with grip (TWG), pause time (PT), the percentage of combat time in *tachi-waza* and combat in *ne-waza*, and the frequency of combat/tactical/technical actions/tasks. Data were descriptively analyzed overtime during the 2013, 2014, 2015, and 2017 World Championships and the 2016 Olympic Games. Data from 3,084 male and female matches across weight and gender categories were collapsed and used to compare the TMT, CT, TWOG, TWG, PT, and frequency of tactical actions over time and by competition phase (i.e., qualifiers, quarterfinals, recaps, semi-finals, bronze and finals). There were several temporal changes that occurred due to the rules modifications. The TMT increased by 3.6% over the sampling period for all competition phases. Regarding the duration of combat activities, relative to TMT: 25% was spent in PT ( $M$  PT = 8.9 s); 36% ( $M$  TWG = 9.6 s) was spent in TWG; 25% ( $M$  = 7.3 s) was spent in TWOG; 15% was spent in *ne-waza* ( $M$  = 7.7 s per action). With the changes of the rules in 2017, there was a Golden Point Score increase of 25% in the total number of combat; in relation to the competition phase, there was a 50% increase in the total number of combat activities. There was also a 15% increase in the number of actions in the competition final phase. There was some variation of the time structure of the combat, namely in the total time of the fighting and Golden Point, as a consequence of the change of the Referee rule changes.

**Keywords:** Martial arts; combat sports; judo; performance analysis, combat analysis.

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### 1. Introduction

Judo is a high-intensity intermittent combat sport, in which many physiological attributes are necessary to achieve optimal technical-tactical development and competitive success (Franchini et al., 2011a; Monteiro, 2003). Judo matches comprise efforts of about 20-30s and pauses of approximately 10s in duration, until the regular 4min period is ended (Franchini, Takito & Calmet, 2013; Miarka et al., 2012; Monteiro, 1995). According to the international rules senior judo matches are limited to 4min (in case of draw, an extra-time with no time limit takes place until the first athlete scores a point). However, studies have consistently shown that mean duration of judo matches is about 3min, regardless of the level of competition (Miarka et al., 2012; Castarlenas & Planas, 1997). In a typical match, athletes perform approximately 11 periods of activity (Marcon et al., 2010; Castarlenas & Planas, 1997; Monteiro, 1995). Based on the data from these investigations, it may be observed that periods of activity vary from 10 to 63s and pause periods vary from 1 to 22s, while the activity-pause ratio is normally 2:1 or 3:1. This appears to be similar between men's and women's competitions (Hernández-García & Torres-Luque, 2007). Additionally, before engaging in grappling disputes, athletes approach each other to obtain an optimal grip position, which may confer an advantage to execute a throwing technique (Calmet et al., 2010; Marcon et al., 2010). This approximation requires a high level of attention and information processing concerning

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the opponent's action (Calmet et al., 2010). Once the grip is established, the athlete attempts to dominate their opponent, disrupt his/her balance and execute a throwing technique (i.e., *nage-waza*). In fact, most of the active time (~50%) is spent in grip dispute without a strong metabolic effort (Calmet et al., 2010; Marcon et al., 2010). Execution of *nage-waza* requires a powerful action of short duration (1.0-1.4s), (Hernández-García & Torres-Luque, 2007; Marcon et al., 2010). Due to difficulties in conducting physiological measurements during a match (Artioli et al., 2012; Calmet, 2007, Monteiro, 1995), studies interested in the physiological responses to judo have used one of several strategies: to conduct time-motion analysis to infer the metabolic profile of judo matches (Marcon et al., 2010; Miarka et al., 2012; Castarlenas & Planas, 1997; Monteiro, 1995, 2003).

## 2. Objectives

The present study assessed the evolution of the total match duration, the time without grip (TWOG) and with grip (TWG), pause time (PT), and frequency of actions across competition phases between the World Championships in 2013, 2014, and 2015 versus after the rule changes implemented in the 2016 Olympics and the 2017 World Championships.

## 3. Methodology

This study descriptively compared the total duration of combat, activity and stop times, as well as the frequency of actions, between the World Championships in 2013, 2014, and 2015 versus the 2016 Olympic Games and 2017 World Championships by competition phase (qualifiers, quarterfinals, recaps, semi-finals, bronze and finals). Data were collapsed across weight category and gender. Through the use of digital recordings of each match, data were analyzed in the World Championships in 2013 ( $n=680$ ), 2014 ( $n=670$ ), 2015 ( $n=714$ ), 2017 ( $n=602$ ) and 2016 Olympic Games ( $n=418$ ) in a total of 3084 male and female.

## 4. Results

Several descriptive changes in the tactical aspects of elite judo competition occurred pre- vs. post-rules change in 2016. Specifically, there was a 3.6% increase in TMT following the rules change. Similarly, TMT increased by 46.7% in the quarterfinal matches, 9.7% in the bronze medal matches, and 19.2% in the final matches. Mean time engaged in combat (CT) was 206s. The CT during the final phases was 244s using the traditional rules, whereas the CT was reduced to 215s during the finals following the rules change (2016 and 2017). Overall, 25% of TMT was spent in PT ( $M = 8.9s$  per pause), 36% of TMT was spent in TWG ( $M = 9.6s$ ), 25% of TMT was spent without activity grip ( $M = 7.3s$  per activity); 15% of TMT was spent in *ne-waza* ( $M = 7.7s$ ). With the changes of the rules in 2017, there was a Golden Score increase of 25% in the total matches; there was a 50% increase in the competition final phase. The total number of combat actions was constant over the years, with an average of 32 actions per match (25 activity actions and 8 pause actions). There was also a 15% increase in the number of actions in the competition final phase.

## 5. Discussion

The total match time was longer in the 2017 World Championship compared to the 2013 World Championship. The total time increase in 2013 versus 2017 can be explained by the rule change that reduced the time limit from 5min to 4min, although the fighting time has decreased, however with the exponential increase of the Golden Score has led to a 3.6% increase in total combat time. The findings indicated that the rules changes were not effective to decrease the combat total time and the real time. One important finding of the present study was to characterize the mean activity time combat with grip (i.e. 9.6s) and without grip (7.3s) suggesting that the effort-pause can be analyzed in another dimension. These findings are informative to assist coaches and athletes regarding preparation for the tactical parameters encountered during elite judo competition (Baudry & Roux, 2009; Franchini et al., 2013). In this studies, the grip dispute time was 61%, *ne-waza* was 14% and pauses 25% of TMT. Marcon et al. (2010) reported that the grip dispute time represented  $49\pm 10\%$  to  $56\pm 9\%$  of total effort time, while the data from Miarka et al. (2012) allow to calculate that gripping disputes represented 58% of all standing combat time and 28% of the whole combat time (i.e., pauses included). The results of our study reported: Pauses, 8.9s; TWOG, 7.3s; TWG, 9.6s; *ne-waza*, 7.7s. Very similar results were reported by others (Miarka et

al., 2012), with the preparation period lasting  $5\pm 8$ s, the gripping dispute lasting  $14\pm 15$ s and the groundwork combat lasting  $15\pm 14$ s when standing sequences were continued in this condition. In our study the pause with the TWOG was 16.2s, and TWG with *ne-waza* was 17.3s. Thus, after a low-intensity approximation, athletes engage in the most time-demanding task, i.e. to establish the grip dominance over the opponent. The effort-pause ratio can be analyzed with a new dimension: 1:1 or 1:2.

## 6. Conclusion

There was some variation of the time structure of the combat, namely in the total time of the fighting and Golden Score, as a consequence of the change of the referee rules. In conclusion, our results can be applied to the planning and prescription of specific training for the different phases of the competition, taking into account the activity times, pause times, total combat times, effort-pause ratio and the specific frequencies obtained in the different phases of the competition.

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