

# Analysis of the final fights of the judo tournament at Rio 2016 Olympic Games

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**Key words:** judo, combat sports, struggle dynamics, technical preparation, tactical preparation

## Summary

**Introduction** Analyses of the actions taken at start by the contestants of martial sports can deliver a considerable amount of valuable information for the coaching staff. The aim of this study was to establish the combat dynamics and to characterise the most frequent offensive and defensive actions taken by the finalists of the judo tournament at Rio de Janeiro Olympics.

**Materials and methods** The research has been executed on the basis of the recordings of 14 final combats at 2016 Olympic Games. 28 contestants, representing 17 countries, took part in the tournament. The analysis was performed on the basis of the Kalina's method of combat dynamics measurement, with an author's modification. The offensive actions were classified according to Kodokan Judo classification (throws: hand throws, hip throws, leg throws, and grapples: holds, chokes, levers). The conventional division on 12 defensive techniques was adopted for the purpose of their analysis and presentation.

**Results.** The activeness of the contestants amounted, on average, to 0.33, which means that for 2/3 of their combats, judokas did not take any offensive or defensive actions. No statistically significant differences in any element of combat dynamics were observed between men and women. By comparing gold and silver medal winners, it was determined that the final combats winners showed significantly higher effectiveness of attack and defensive actions as well as general combat dynamics. Leg and hand throws were the most frequent offensive actions. However, holds were the most effective actions (50%). Hand block was the most frequently used defensive technique.

**Conclusions** (1) The low level of activeness and offensive activeness demonstrated by the judokas (including gold medal winners) indicates that the contestants made fewer attempts to gain advantage through their technical actions. (2) The final combat winners executed leg throws nearly four times more often. The effectiveness of these actions was very high (30%). Whereas, the silver medal winners much more often made attempts of hand and hip throws, which were ineffective.

## Introduction

The effectiveness of training process is evaluated in terms of the results achieved by a contestant during a tournament. The combat success is influenced by comprehensive motor preparation as well as by psychical, technical and tactical preparation. However, the contestants' fitness not always determines their sporting performance. The purpose of judo training is the optimal development of motor skills. As shown by numerous studies, contestants competing on the highest level, and participating in the world's most important championships, do not significantly differ in terms of their motor preparation [1,2]. They are also similar in respect to their physical build and body composition [3,4], or psychological condition [5,6]. The factors that differentiate them most are their specific coordination abilities, and technical and tactical skills, gained through many years of trainings, multiple repetitions of specific movement sequences, and thousands of training and tournaments fights [7-10]. According to experienced judo coaches, technical and tactical preparation is the factor that determines the sporting result [11]. The observation and analysis

of the actions taken by contestants at start provide coaches with an insight into what determines a winner in the combats between the best contestants. This is particularly important since the regulations of judo fights are often modified, while even seemingly minor changes force the contestants to adopt other methods of the preparation and realization of offensive and defensive actions during a combat [12-15].

In the recent ten years, there were substantial changes to the regulations. The 2006 reform was intended to limit the role of the referee during a combat. Changes were applied to the regulation concerning fighting at the edge of the mat in a standing posture (*tachi-waza*), which allowed contestants to continue the action when one of the contestants remains in contact with the combat area. In 2006 and 2007, there were implemented recommendations to liberalise the way in which the passivity of contestants was evaluated, thus liberalising the penalties for the lack of activeness. In 2009, a limitation was introduced on gripping the pants' leg of the opponent. It was allowed only to grasp the opponent's leg but not directly the pants leg (which resulted in a *shido* penalty). Extra time was shortened from 5 to 3 minutes. In 2010, gripping the opponent be-

low the belt was prohibited, and such infringement became penalised with a disqualification – *hansoku-make*. Gripping below the belts was permitted only in the case of a counterattack or recurrence of the contestant's attack. After 2012 Olympics in London, it was prohibited to grip the legs in *tachi-waza*. The regulations concerning the extra time were also changed. Since then, if a fight ends in a draw, the extra time (golden score) is added until one of the contestants gains an advantage – without a time limit. Thus, the controversial rule of selecting the winner by the judges' decision – so called *hantei* – was eliminated. Another modification was related to *shido* penalties – they no longer result in gaining a score by the opponent. In 2014, the regulations regarding passivity and fighting for a grip were tightened (contestants have to aim to plant a correct grip immediately), and the combat time in the women's category was shortened from five to four minutes [16]. Monitoring the current trends in what decides a winner is, therefore, highly relevant to both coaches and contestants. It can also be a guideline for persons who make decisions regarding the regulations. The intention behind all the changes implemented so far was turning judo into a discipline which would be more attractive and appealing to the audience. The main cognitive purpose of this study was to establish the combat dynamics and to characterise the offensive and defensive actions taken by the world's top judo competitors, based on the example of the final contests at the judo tournament at Rio de Janeiro 2016 Olympics. The applicative purpose was to lay down the training assumptions and methodical directives regarding the optimisation of combat strategy and tactics, taking into account the combat regulations currently in force.

## Materials and methods

The research material comprised of the recordings of gold medal combats at the judo tournament at Rio de Janeiro Olympics (6-12.08.2016). 14 combats were analysed with an accuracy to 10-second sequences. The total time of the analysed combats amounted to 54 minutes and 51 seconds (334 sequences).

28 judokas (14 women and 14 men) from 17 countries participated in the combats. Most participants represented France and Japan (4 participants each), and Azerbaijan, South Korea, Russia and USA (2 participants each).

For the purpose of comparison, the contestants were divided into groups taking into account their placement (gold and silver medal winners) and sex (women and men).

According to the Kalina's method of combat dynamics measurement [17], with author's modification [18], all actions were recorded (on observation sheets) in 10-second fight sequences: attacks and counterattacks (throws, holds, chokes, levers), defence without counterattack – defining their effectiveness, as well as preparatory actions, breaks, decisions of referees [17,18]. In each category, events are recorded in the form of proportions of relations: the number of successful actions against the number of observed actions belonging to this group, which may be expressed in a 0 to 1 index of arbitrary

units. Events (in 10-second combat sequences) are recorded in the form of arbitrary symbols or in the form of brief description [17]. The basic criteria for evaluating the dynamics of combats include variables expressed in corresponding indexes:

Offensive and defensive activeness index, or the activeness index (AI), which is a proportion of 10-second combat sequences, during which a contestant attempted at least one attack, counterattack or defence without counterattack against the number of 10-second combat sequences.

Offensive activeness index (OA), which is a proportion of the number of 10-second combat sequences, during which the contestant attempted one offensive action (attack), aiming at gaining an advantage, to the number of all sequences in a fight.

Offensive actions effectiveness index (EA), which is a proportion of the number of attacks awarded with scores to the number of attacks made.

Counterattacks effectiveness index (EC), which is a proportion of the number of counterattacks which were awarded with scores to the number of counterattacks made.

Defensive effectiveness index (ED), which is a proportion of the number of successful defensive actions (excluding a counterattack) to the number offensive actions taken by the opponent, with the exception of attacks which were followed by a counterattack of the contestant.

The average value of particular components used in the description of the events taking place in a fight is referred to as the general fight dynamics index (SDI) [17].

The analysis and presentation of the offensive actions of the contestants incorporates the Kodokan Judo classification of throwing techniques (*nage-waza*), performed in a standing posture; falling throws, the so-called sacrifice throws (*sutemi-waza*); and grapples (*katame-waza*), performed in a supine posture [16].

The throws are presented according to the following groups: *te-waza* (hand throws), *goshi-waza* (hip throws), *ashi-waza* (leg throws), *sutemi-waza* (sacrifice throws) – in Kodokan Judo classification, the *sutemi-waza* group is divided into *ma-sutemi-waza* (back sacrifice throws) and *yoko-sutemi-waza* (side sacrifice throws), but due to small number of recorded throws of the two categories they were presented jointly as *sutemi-waza*. The grapples are presented according to the following groups: *osaekomi-waza* (holds), *shime-waza* (chokes), *kansetsu-waza* (levers). Generally adopted Japanese judo terminology is applicable [16].

The conventional division on 12 defensive techniques was adopted for the purpose of their analysis and presentation: hand block, hip block, manoeuvring around, twist onto belly, hand and hip block, hand block and manoeuvring around, stepping aside, separation from grasp, leaving the mat, leg entanglement, bridge, return to *tachi-waza* [19].

The data were processed using standard methods of statistical analysis, arithmetical means and standard deviations. The significance of differences between particular groups was evaluated using Mann-Whitney U test. The minimal statistical significance was set at  $p \leq 0.05$ . The results were calculated in

MS Excel and Statistica 10 computer packages, license owned by Warsaw Medical University.

## Results

The average activeness of contestants (expressed in AI index) amounted, on average, to 0.33, which means that for 2/3 of their combats the judokas did not take any actions (neither offensive nor defensive), executing only preparatory actions. Women demonstrated higher activeness (0.37) than men (0.3), but it should be noted that a women's combat lasts four minutes, while a men's combat – five minutes. No statistically significant differences in any element of combat dynamics were observed between men and women (Figure 1).

By comparing gold and silver medal winners, it was determined that the final combats winners demonstrated signifi-

cantly higher effectiveness of attack (EA) and defensive actions (ED) as well as the general combat dynamics expressed by SDI index. The difference close to significance ( $p=0.15$ ) was observed in the category of offensive activeness (OA). It is worth mentioning that silver medal winners did not execute any actions awarded by the referees, which means that the leader did not change during any of the fights – the contestant who scored first was the one who won (Figure 2).

In 14 fights, 108 technical actions were noted in total (throws or grapples), 16 (15%) of which were effective. The contestants more often attempted throws (*nage-waza*) in a standing posture (*tachi-waza*). Grapples (*katame-waza*) used in a supine posture (*ne-waza*) were rare (amounted only to 7% of all offensive actions). *Ne-waza* actions were executed more effectively; each of every two actions (50%) was awarded with

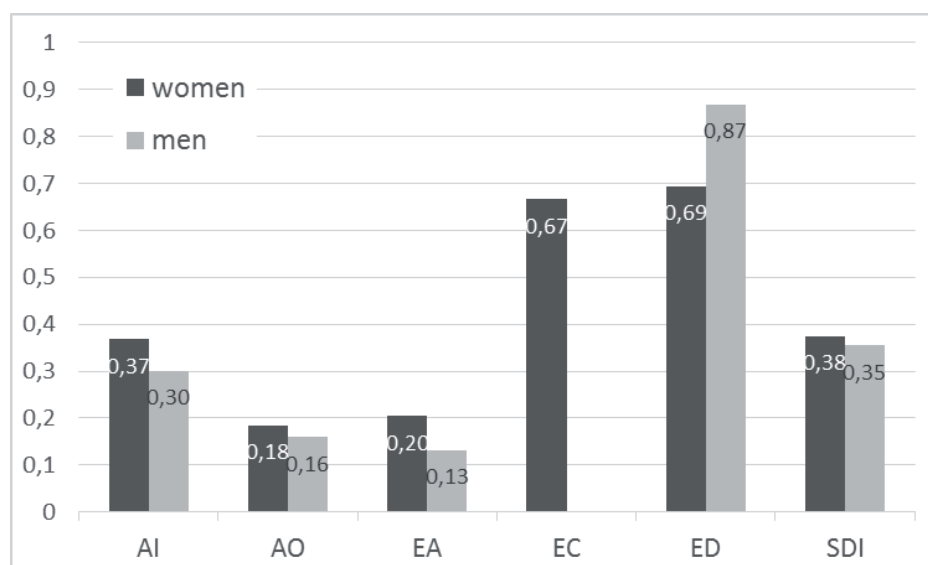


Fig. 1. Elements of struggle dynamics of female and male judokas

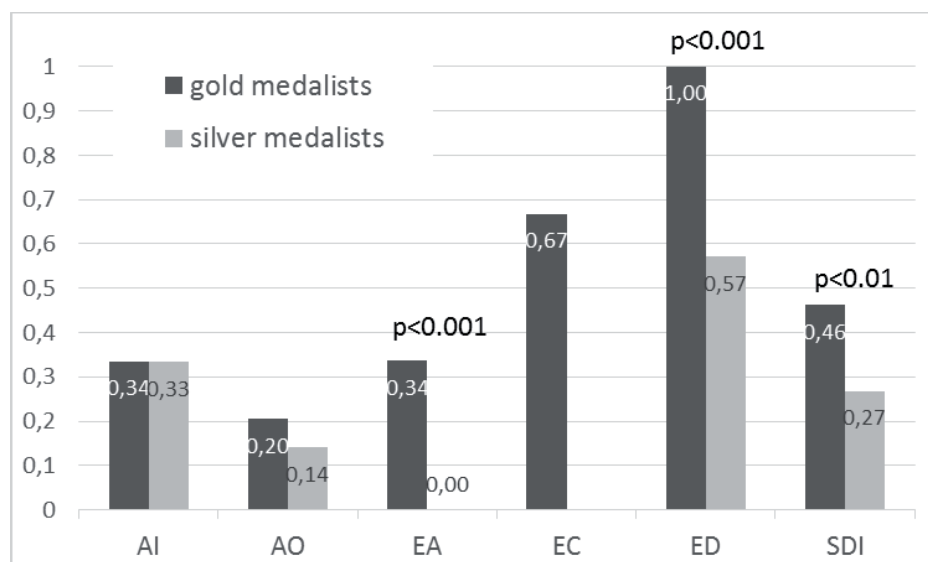


Fig. 2. Elements of struggle dynamics of gold and silver medalists

a score, while only 12% of throws were awarded by the referees. Judokas executed left-side actions more often and more effectively, but the differences were not significant.

Leg throws (*ashi-waza*) and hand throws (*te-waza*) were among the most frequently used defensive techniques. Hip throws (*goshi-waza*) and sacrifice throws (*sutemi-waza*) were attempted less often. Leg throws were the most effective – ten of them were awarded by the referees, which made up 63% of all technical actions that received a score. Grapples in a supine posture (*ne-waza*) were executed no more than occasionally. Holds (*osaekomi-waza*) were executed in the most effective way; 38% of them proved to be effective. There were no significant differences noted between men and women as to the effectiveness of executing particular actions (Table 1 & 2).

Most frequently, the contestants defended themselves through a hand block (3.57 events per combat on average), twist onto belly (1.86) and manoeuvring around (1.5). The least effective actions were manoeuvring around (effective in 50% of cases), twist onto belly (65%) and hand block (80%). Hip

block, manoeuvring around, leaving the mat, stepping aside, hand and hip block and separation from grasp were executed with 100% effectiveness. There were no actions classified as leaving the mat, hand block and manoeuvring around, bridge or return to *tachi-waza* (Table 3 & 4).

The average length of a final combat amounted to 235 seconds; in the women's group almost 233 seconds, and in the men's group 237 seconds. It means that the women's fights lasted on average 97% of the regular combat time (4 minutes), while the men's fights lasted 79% of the base time (5 minutes). In 14 final combats, the contestants executed 16 actions awarded by the referees (1.14 action per combat) (Table 5). An effective technical action was executed once in every 3 minutes and 25 seconds. The contestants were given slightly more warnings (17), while only in one combat (+100 kg men) the contestants were not awarded with any scores for technical actions (the winner was the contestant with the lower number of penalties). Interestingly enough, the final combats winners received penalties more often than the losers (Table 6).

Tab. 1. Number of offensive actions performed by female and male judokas

Groups	All/ effective	Te-waza	Goshi-waza	Ashi-waza	Sutemi-waza	Osaekomi- waza	Shime-waza	Kansetsu-waza
Women	all	19	7	12	6	4	1	1
	effective	1	0	3	0	3	0	1
Men	all	13	3	30	9	1	0	1
	effective	0	0	7	0	0	0	0

Tab. 2. Number of offensive actions performed by gold and silver medalists

Groups	All/ effective	Te-waza	Goshi-waza	Ashi-waza	Sutemi-waza	Osaekomi- waza	Shime-waza	Kansetsu-waza
Gold medalists	all	9	2	33	8	4	0	2
	effective	1	0	10	0	3	0	1
Silver medalists	all	23	8	9	7	1	1	0
	effective	0	0	0	0	0	0	0

Tab. 3. Number of defensive actions performed by female and male judokas

Groups	All/ effective	Hand block	Hip block	Maneuvering around	Twist onto belly	Stepping aside	Hand and hip block	Separation from grasp	Leg entanglement
Women	all	18	0	11	15	1	2	5	2
	effective	14	0	11	7	1	2	5	1
Men	all	32	2	10	11	0	0	3	0
	effective	26	2	10	10	0	0	3	0

Tab. 4. Number of defensive actions performed by gold and silver medalists

Groups	All/ effective	Hand block	Hip block	Maneuvering around	Twist onto belly	Stepping aside	Hand and hip block	Separation from grasp	Leg entanglement
Gold medalists	all	20	2	14	7	1	0	3	0
	effective	20	2	14	7	1	0	3	0
Silver medalists	all	30	0	7	19	0	2	5	2
	effective	20	0	7	10	0	2	5	1

Tab. 5. Average time of fights, number of sequences, scores and penalties

Groups	Time [s]	Sequences	Scores	Penalties
All	235.07	23.85	1.14	1.21
Women	232.71	23.57	1.28	1.57
Men	237.43	24.14	1	0.86

Tab. 6. Number of scores and penalties

Groups	Scores	Penalties
Gold medalists	16	11
Silver medalists	0	6

## Discussion

The analysis of the actions taken by contestants at start should be an integral part of planning technical and tactical training. The data derived from such analyses might be used by coaches for effective planning of technical and tactical skills training as well as combat strategy planning in relation to particular contestants and their potential opponents. Currently, the actions taken by contestants at start frequently do not correspond to the exercises done during the training. It should also be pointed out that the analysis of the effectiveness and frequency of executing particular throws and grapples might not be sufficient. This is because the preparatory actions, which occupy more than a half of the combat time, play a significant part [20-22]. The training of the contestants competing at all levels should, therefore, include exercises devoted to strengthening the elements which are most effective in terms of the sporting result. It should be stressed that such elements are not always the throws and grapples defined by Jigoro Kano. With an increasing frequency, achieving a success in sport depends on conducting a fight in such a way so that the opponent is given a penalty, instead of executing a successful technical action [10,15,20,23].

Research shows that the actions taken at start by men and women do not differ to a significant extent [20,23], despite obvious differences in body composition or physiological indicators [24,25]. The differences in how the fights are settled can be observed more often in the case of contestants competing on different levels, or different weight categories, and – as in the present study – winners and losers. In fact, in a judo fight, it is very rare that the dominant position shifts from one contestant to another. More often, the winner is the contestant who is first to execute a technical action awarded by referees. After gaining an advantage, the contestants can effectively defend themselves until the fight ends. The current regulations allow that, since the warnings for passivity, feint attacks, or overly defensive behaviour do not result in awarding scores to the opponent [16].

The subject of the presented study was the analysis of the final combats. Such selection was intentional, as only the analysis of the fights of the world's top contestants competing with equally skilled opponents can give an answer to what

fighting methods and measures are most effective. The analysis may also raise the awareness of how a judo fight looks like in the view of the currently applicable regulations, and may be a point of departure for future comparisons. The presented results show that the regulations significantly affect the way the contestants fight. Comparing to London Olympics, the activeness of the contestants significantly decreased, and the dominant technical measures employed in a fight changed [20,26].

The International Judo Federation (IJF) and European Judo Union (EUJ) are still looking for new solutions. The purpose of the changes made in recent years was to make judo a more attractive sports show. However, studies demonstrate that the audience figures are correlated to combat dynamics and activeness of the contestants – and these are decreasing [27]. So far, therefore, the changes have not turn judo into a more attractive discipline. Instead, they contributed to losing practical values (e.g., the absence of leg grapples), and it has to be remembered that judo is not only a sport but also an art of self-defence.

## Conclusions

1. The low level of activity and offensive activity demonstrated by the judokas (including gold medal winners) indicates that the contestants made fewer attempts to gain advantage through their technical actions. This aspect should be taken into account while planning and conducting technical and tactical training of judokas.
2. The final combat winners executed leg throws nearly four times more often. The effectiveness of these actions was very high (30%). Whereas, the silver medal winners much more often made attempts of hand and hip throws, which were ineffective. It is caused by the current regulations, which force contestants to plant a grip as soon as possible and forbid grips below the belt.
3. The champions much more often attempted to win the fight using grips in a supine posture. The actions of such kind were highly effective, which should serve as an indication for both coaches and contestants that they should not forget about perfecting grapples, chokes and levers during their trainings. Especially, as the current referee pro-

cedure allows for taking more time in executing *ne-waza* actions.

should be no substantial differences in their technical and tactical skills training.

4. Keeping in mind how similar are the methods and measures employed by men and women during a fight, there

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Received: 01.09.2016

Accepted: 05.10.2016