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## COACHING

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# The course of the judo fight in the heaviest category (+100kg) seen from the perspective of attacks in the standing position, based on the Olympic Games in London 2012

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**Key words**: judo fight, statistic of attacks in the standing position, Olympic Games

**Abstract:**
This study ought to create a statistical picture of the judo fight in the standing position and analyse the changes in the picture of the next minutes of judo fight for useful coaching work materials.
Video analysis included all the judo fights (with attacks in standing position) in the heaviest weight category during the Olympic Games in London 2012. The Efficiency and Effectiveness indicators were calculated and used to present the fight structure as a function of the performed attacks number.
There were observed different trends in the number of attacks: decrease in the number of attacks backwards, increase in the number of attacks forwards and in the effectiveness of attack, which resulted in the changing course of the fight.
Creating a new (after the changes of regulations) course of a judo fight gives additional possibilities of improving training work. It makes the evaluation of the effectiveness of the introduced changes in judo regulations is possible.
Additionally, this course should be compared to the Polish Championships and confronted with the results of Polish champions at international championships.

## Introduction

Judo has been an Olympic sport since 1972 but the first judo competitions for general public were held in 1964 in Tokyo. The first European Championships was in 1951 in Paris and World Championships in 1956 in Tokyo [Hicks, Soames 2001].

Formulated in the past, the principles of Judo by Jigoro Kano [Shishida 2011] are valid to this day, although were changing the weight categories and ability to watch judo fight (TV, Internet TV, Fan Clubs).

In addition, the changes of regulations include introducing visual values (judoga colour, back numbers, colourful protection zones, the obligation of formal clothes for coaches and contestants, etc.), rewarding the offensive stance in the fight by promoting attacks and punishing for combat avoidance.

In 2010 the prohibition of direct hand attack to the leg was introduced. It should be noted that the hand attack to the feet as a combination of contra attacking or the one performed during the "one-sided grip" of the opponent is still allowed.

It is obvious that for an ordinary fan eye-catching spectacular fighting techniques, fights finished before the proper time or the ones in the heaviest category between powerfully built opponents are the most attractive. The time structure of the judo combat, contestant profiles and technical-tactical preparation have been the subject of studies of not only professional judo athletes [Adam *et al.* 2012], but disabled fighters as well [Gutiérrez-Santiago *et al.* 2011].

The impact of changes in sport and judge rules on the effectiveness of the techniques used in judo combat has been the subject of analysis by many authors [Boguszewski 2011; Adam *et al.* 2011]. Trainers use various measurement techniques at their work, including those with complex instrumentation as well as those with all types of recorders including visual ones.

Recording of the competition and precise analysis is the standard of modern coaching work in various sports. A similar study of sprinters [Trezise *et al.* 2011] analysing the structure of movement with the use of video recording and film analysis can serve as an example. The video recording technique was also indicated as an effective one in the work of less experienced trainers [Carson 2008]. The standards in a trainer work are physiological and medical examination conducted on young judo competitors in the spirometry field [Pujszo *et al.* 2011], biochemistry studies concerning the physical efforts on the example of maximum power obtained after successive judo fights [Bonitch-Domínguez *et al.* 2010], problems of a single throw in judo [Bonitch-Domínguez *et al.* 2007], problems of recovery of energy in the judo fight [Degoutte *et al.* 2003] and many others.

An interesting example of interdisciplinary research in biochemical and psychological measurements was the level of testosterone in combination with aggressive behaviour in judo fights recorded on video. A positive correlation was observed in this case [Salvador *et al.* 2007]. These examples demonstrate a great diversity of research both in the subject matter and the methodology of measurement.

The results of body postural control of female judo athletes after successive fights during the Academic Championship in Poland were equally interesting [Błach *et al.* 2005].

Following this research mainstream judo trainers - the authors of these studies used the video footage to provide a complete statistical analysis of judo attacks performed in the standing position during the Olympic Games in 2012 in the heaviest category (+100 kg).

The aim of the analysis was to create a picture of the heavyweight fight at the Olympic Games taking into consideration the fact that it was created by successful competitors. The picture occurred after the considerable change of judo regulations. The comparison of this picture to the one observed at the Poland Championships will allow creation of training strategy and ending the fight leading to the success of Polish competitors.

## Material and methods

All data was collected directly during the analysis of the video recording of judo fights in heaviest category (+100 kg) in the course of the Olympic Games in London 2012. 32 competitors took part in the heaviest category and there were 34 fights.

The fights were filmed by one person entitled by Polish Judo Association. The video camera was equipped with all the features that make a detailed analysis of the fight possible. The written record of the fights was made separately by two judo coaches-experts. Both people worked separately using the same standard computer equipment to read the video record (stop frame, magnifying, slow motion, reversing, 32" screen, screen resolution 1280/960).

The recognition of the attacks backwards, forwards, situational and their record in numbers was made individually.

The statistical reliability of the information record made by both two experts was calculated using PQStat. v.1.4.4 programme. The Cohen's-kappa index was calculated on 88,2%.

The authors decided to analyse selected parts of a judo fight like: attacks forwards - with deflection on the toes, attacks backwards - with deflection on the heels and situational attacks - with deflection in no precise direction. The actions on the ground (ne waza) due to the small number (5 shares) were not analysed. The total time of the fight, including the overtime for play-off, until the final verdict was analysed.

If such attacks or actions did not occur (injury, disqualification) the fight was not analysed (1 case - the fight No. 12, the contestant did not appear to fight - Fusen-gachi).

All results of the research concern only the mentioned above elements.

The analysis concerned all the attacks observed in the video recording:

1. awarding points: attacks backwards, attacks forwards, situational attacks.

2. not awarding points: attacks backwards, attacks forwards, situational attacks.

3. not awarding points: attacks backwards,

attacks forwards, situational attacks that directly resulted in a penalty and gave points to the attacker.

4. time for points awarding attack, or penalty by the opponent.

The following indicators were calculated: the efficiency of attack (Ea), the effectiveness of the fight (SA), which concerned all performed attacks.

The Efficiency indicator was calculated with the following formula:

$$Ea = \left(\frac{l_0}{l_1 + l_0}\right) * 100 \qquad \text{Eqn.1}$$

where
$l_0$ - number of: awarding points attacks backwards, attacks forwards, situational attacks
$l_1$ - number of: not awarding points attacks backwards, attacks forwards, situational attacks

The Effectiveness indicator was calculated with the following formula:

$$Sa = \left(\frac{S_0}{L_w}\right) * 100 \qquad \text{Eqn. 2}$$

where
$S_0$ - total points received by attacks in all fights
$L_w$ - the total number of all analysed fights with an attack backwards, an attack forwards and a situational attack.

The minute structure of the fight as a function of the total number of attacks, and as a function of the total number of points was presented in the graphs of linear regression and in the graphs of minute regression. To describe the strength of the correlation between the variables, the determination index $R^2$ was used.

The statistical material was developed with the "Excell 2007" (equations, tables, graphs, line of trend, determination indicator – $R^2$) and PQStat. v.1.4.4 programme (Cohen`s indicator).

**Table 1.** Basic data of the collected research material - judo fights with: the attack backwards, the attack forwards and the situational attack during the Olympic Games in 2012 in London.*

| | Total number of fights | The number of fights with attack forwards | The number of fights with attack backwards | The number of fights with situational attack forwards | Number of fights finished before the time | Number of fights finished before the time of the attack backwards | Number of fights finished before the time of the attack forwards | Number of fights finished before the time of the situational attack |
|---|---|---|---|---|---|---|---|---|
| n | 34 | 31 | 33 | 27 | 13 | 6 | 7 | 0 |
| % | 100 | 91.2 | 97.1 | 79.4 | 38.2 | 17.6 | 20.6 | 0 |
| number of points | 260 | 112 | 138 | 10 | - | 60 | 70 | 0 |

* There were observed five double-sided passive penalties for the fight which had no effect on the points scored in the fight - they are not included in Table 1.

**Table 2.** Calculated values of the collected research material - judo fights with: the attack backwards, the attack forwards and the situational attack during the Olympic Games in 2012 in London.

| indicators | $E_a$ | $S_a$ | $l_1$ | $l_0$ | $l_o+l_1$ | $S_0$ | $L_w$ |
|---|---|---|---|---|---|---|---|
| values | 5.54 | 7.65 | 37 | 638 | 675 | 260 | 34 |

**Table 3.** The distribution of the total points number in heavy weight (+100kg) in minutes during the Olympic Games in London 2012.

| | Min 1. | Min 2. | Min 3. | Min 4. | Min 5. | play-off 5+ |
|---|---|---|---|---|---|---|
| Number of points | 25 | 50 | 55 | 61 | 44 | 25 |
| The number of attacks awarding points | 3 | 6 | 8 | 8 | 6 | 4 |

**Table 4.** The distribution of all carried out attacks in the heavyweight (+100kg) in minutes during the Olympic Games in London 2012.

| direction of attack | Min 1. | Min 2. | Min 3. | Min 4. | Min 5. | Play-off 5+ |
|---|---|---|---|---|---|---|
| Attack forwards (number) | 29 | 37 | 32 | 47 | 46 | 37 |
| Attacks backwards (number) | 86 | 64 | 50 | 60 | 52 | 32 |
| Situational attacks (number) | 18 | 31 | 17 | 12 | 12 | 7 |
| Total number of attacks | 133 | 132 | 99 | 118 | 110 | 76 |

**Table 5.** The distribution of the Efficiency indicator (Ea) in the heavyweight (+100kg.) in minutes during the Olympic Games in London 2012.

| | Min 1. | Min 2. | Min 3. | Min 4. | Min 5. | Play-off 5+ |
|---|---|---|---|---|---|---|
| $E_a$ | 2.26 | 4.55 | 8.08 | 8.47 | 5.45 | 5.26 |

## Results

Numerical results of the analysis of all the fights in the heaviest weight category at the London Olympic Games in 2012 are shown in Table 1.

Calculated values of the collected research material - judo fights with: the attack backwards, the attack forwards and the situational attack during the Olympic Games in 2012 in London are presented in Table 2.

The distribution of the total number of attacks in all the fights in the heavyweight 100kg in minutes during the Olympic Games in London 2012 is presented in Figure 1.

The graph shown in Figure 1 indicates a significant decrease in the total number of attacks in the third minute of the fight, then the increase in the fourth minute of the fight, and then a drop in the total number of attacks until the end of the fight. It can be stated that the third minute of the fight is a characteristic point on the graph presented.

The distribution of the total number of attacks backwards, attacks forwards and situational attacks in all fights in the heavyweight (+100kg) in minutes during the Olympic Games in London 2012 is shown in Figure 2. The linear regression is presented on Figure 3.

The graph presented on Figure 2 indicates various courses of the quantitative number of attacks in the subsequent minutes of the fight.

The largest dispersion is shown by the line of quantitative distribution of attacks backwards with a clear downward trend. The characteristic point is the third minute of the fight, when the all lines of regression show a decrease in number of attacks. Since the third minute the lines representing the course of the number of attacks backwards and forwards show a similar course with a growth in the fourth minute of the fight and then a slight decrease. The line of quantitative waveform of situational attack indicates the growth to the second minute of the fight and then a systematic decrease. The third minute should be considered as a characteristic point of the analysed graph.

The regression graph shown in Figure 3 indicates a downward trend in the total number of attacks backwards ($R^2 = 0.78$) and number of situational attacks ($R^2 = 0.57$) in the subsequent minutes of the fight. Determination indicators $R^2$, describing the relationship between the variables are statistically significant at the high level.

The distribution of the number of points scored in all fights in heavyweight 100kg in minutes during the Olympic Games in London 2012 are shown in Figure 4.

From the data presented in the graph of Figure 4 shows that the most of points were scored in the third and fourth minute of the fight.

The minutes distribution of Efficiency indicator (Ea) in the heavyweight 100kg during the Olympic Games in London 2012. presented at Figure 5.

The data presented in the graph on the Figure 5 shows that the highest value of Efficiency indicator (Ea) of fight occurred in the third and fourth minute of the fight.

This ratio does not change practically in the fifth minute and additional minutes of the fight.

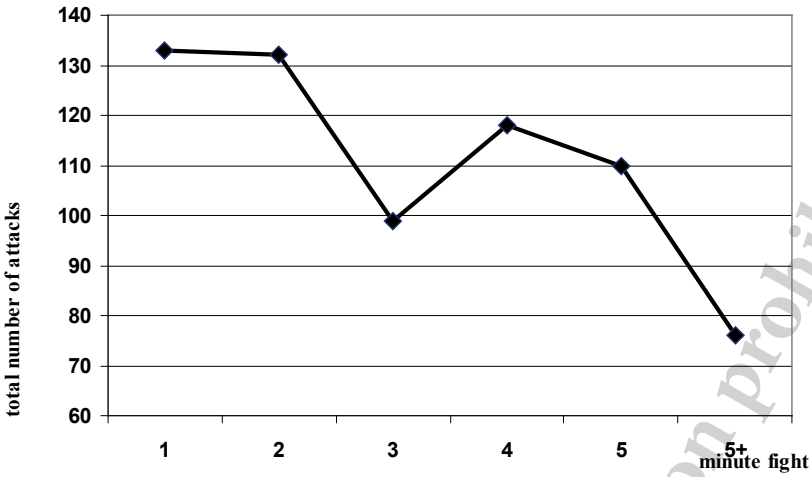


**Figure 1.** The distribution of the total number of attacks in all the fights in the heavyweight (+100kg) in minutes during the Olympic Games in London 2012

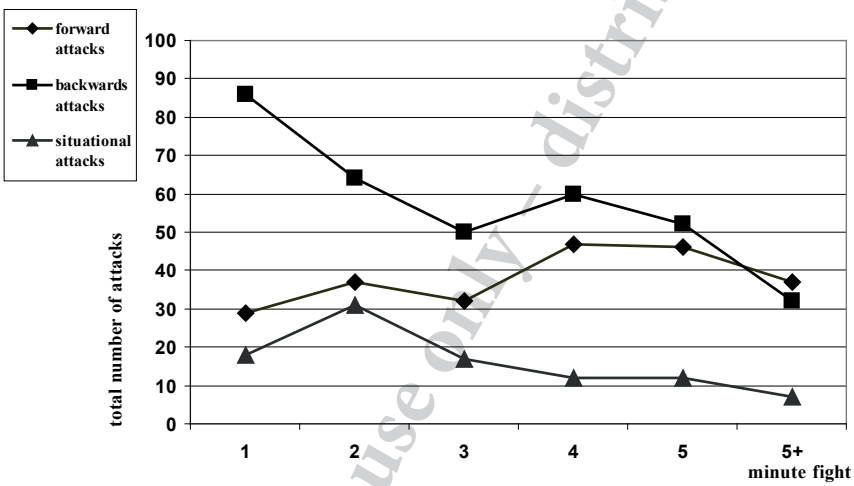


**Figure 2.** The minutes distribution of the total number of attacks backwards, attacks forwards and situational attacks in all fights in the heavyweight (+100kg) in minutes during the Olympic Games in London 2012

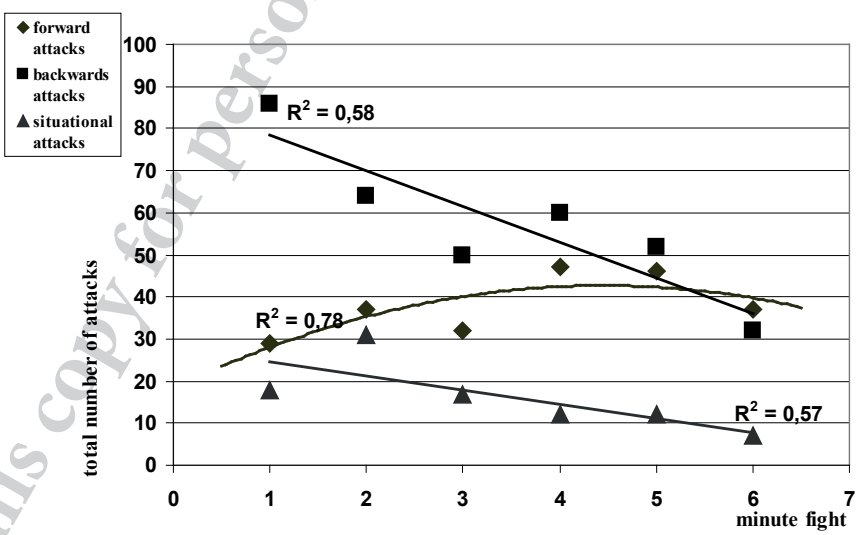


**Figure 3.** The minute regression curve of the total number of attacks backwards, attacks forwards and situational attacks in all fights in the heavyweight (+100kg). during the Olympic Games in London 2012

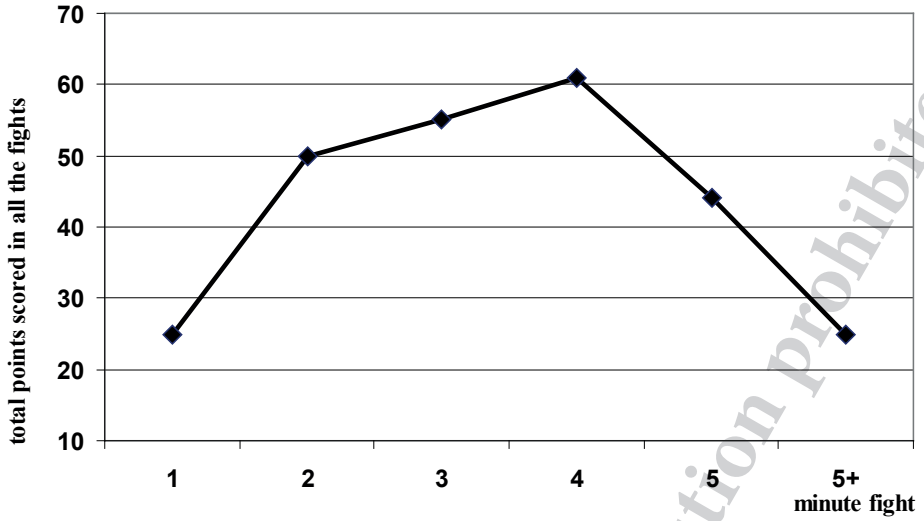


**Figure 4.** The minutes distribution of the number of points scored in all fights in heavyweight (+100 kg) during the Olympic Games in London 2012.

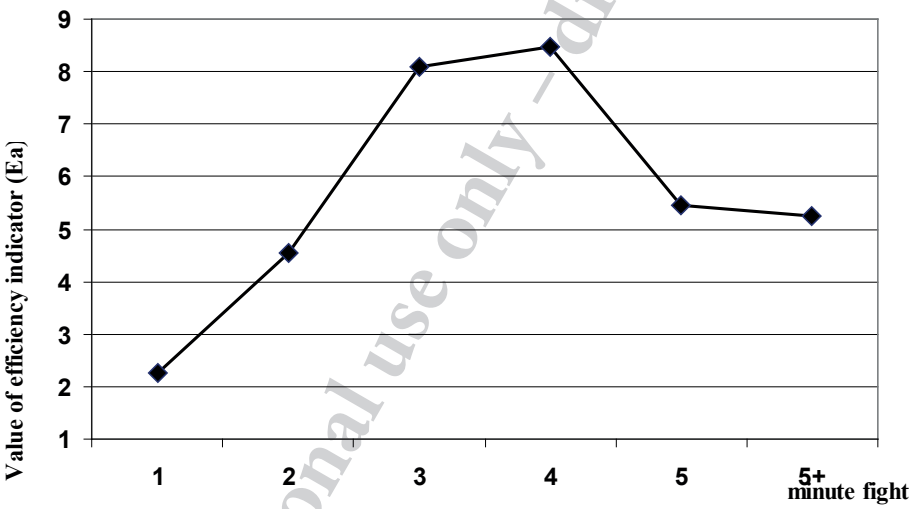


**Figure 5.** The distribution of Efficiency indicator (Ea) in the heavyweight (+100 kg) in minutes during the Olympic Games in London 2012.

## Discussion

The structure of the fight has been repeatedly the subject of research and showed a correlation with physical endurance of judokas [Sikorski *et al*. 1998] and has evolved up to the computer analysis of the fight in terms of time [Kulasa, Kalina 2008].

Preliminary analysis of the data shows that the number of fights finished before the time (38.2%) is higher than that presented in the study of international tournament [Błach *et al*. 2004] but at the same time lower than in other studies [Boguszewski 2010]. This suggests that the indicator of the percentage rate of the fights ended before the time is not constant and may depend on many factors (the rank of the competition, start-up phase of the cycle, weight category, and others)

Presented the Effectiveness indicator of the fight (Sa) is comparable to the average number of points received for effective throws in a single fight [Adam *et al*. 2011]. Also the Efficiency indicator (Ea) indicating the ratio between attempt to attack and effective attacks is lower than in other studies describing Japanese players during the championship event [Adam *et al*. 2010].

In Table 3 demonstrates that in all fights in the heavyweight (+100 kg) 668 (228 forwards, 344 backwards, 92 situational) attacks were made, which

means 19.6 attacks per one fight, 38.4% completed ahead of schedule and 70, 3% of the attacks were performed in all directions. This is the information that describes the dynamics of the observed fighting and also the versatility of the fight in the standing position in the heaviest weight (+100 kg). At the same time there were the five mutual penalties for passivity in fight which did not give any points at this moment and did not have an impact on the result of the fight.

Strong preference for attacks backwards (all throws by leg) is not surprising, because a large group of techniques performed backwards (*ko-soto-gari, ko-uchi-gari, ko-soto-gake* and others) is a part of the preparation for the proper attack, (the main attack is back *o-soto-gari*) and it is an element to show the activity in fight.

The preference of the leg throw for athletes of heavy weight (100kg and +100kg) has already been presented, for example in studies on Polish judokas [Boguszewski 2010].

A similar analysis has been already carried out in the Polish Championships where there has been used the otherwise defined Effectiveness indicator and the authors focused on attacks to the left and right side, and indicating the dominant techniques.

The indicator of the fights which ended before the time was about 55%, but it should be noted that it concerned fighting in all weight categories [Sterkowicz, Maslej 1999].

The presented data suggests a dynamic and comprehensive course of the fight in this weight category.

The minute analysis of the number of attacks shows the third minute as a characteristic point of the fight. Till the third minute the decrease of the number of attacks is observed with the lowest one in the fight (5 minutes).

Then, since the third to the fourth minute of the fight the number of attacks and number of scored points increases and then it decreases until the end of the fight. It should be noted that in terms of the number of attacks backwards - a decrease and attacks forwards - increase, the picture of the fight changes with the lapse of time. In addition, it should be noted that the minute distribution of the points and the value of the Efficiency indicator of the fight Ea have a similar course with the maximum in the fourth minute in regular time of the fight. It should be noted that similar relationships (without extra minutes) were presented on the graphs from the observation of Polish judokas [Sterkowicz, Maslej 1999].

In the fifth minute and extra time of the fight the number of scored points decreases but the Efficiency indicator (Ea) remains at a very similar level and has almost the same value both in the last minute of the fight and during the play-off. The earlier reports on the observation of judo fights in years 1995-1999 also indicate the changing picture of the fight with the passage of time, but present it from the perspective of substitution the leg techniques - Ashi-waza, for hand, and hip techniques - Te-waza and Koshi-waza, in the fifth minute of the fight [Sterkowicz, Franchini 2000].

At the same time the analysis of minute distribution of scored points and the Effectiveness indicator of the fight (Ea) shows that they reach the highest values in the third and fourth minutes of the fight and are followed by their decrease in the subsequent minutes until the end of the fight. The observations carried out during the Polish Championship, despite otherwise defined effectiveness indicator (Ea) revealed similar relationships found in the third minute of the fight. It suggests a question if the third minute of the fight is the turning point of the struggle and requires a separate study [Sterkowicz, Maslej 1999].

Recent studies on the structure of the fight conducted in junior and senior groups, concerning the effective time of the fight, time gaps in the fight, the struggle for the grip etc. suggest usefulness of the results of these observations in planning the physical endurance training and tactical and technical training, too [Miarka *et al*. 2012].

Earlier during the World Judo Championships in 2007, the research concerning the minute structure of the fight was conducted focusing on the preference of the kind of the hand grip and the time to catch the hand grip Despite the differences in the hand grip of men and women it turned out that the traditional grip is privileged [Pierantozzi *et al*. 2007].

The Effectiveness indicator (Sa) and Efficiency indicator (Ea) of the fight have already been observed during the observation of World Cup 2010 and 2011, but significantly higher values were probably noted due to the fact that the world's elite of judo athletes in their respective weight categories were analysed [Adam *et al*. 2012].

Analysis of the technical diversity of the global elite judo indicated a greater variety, greater number and directional diversity of throw performed by the "super elite" judo [Franchini *et al*. 2008].

A more detailed minute analysis of the existing attacks presented in the graph in Figure 2 confirms the distinctive role of the point of the third minute of fight as both the number of attacks forwards, backwards and situational attacks decreases to the third minute and to rise again in the case of attacks forwards and backwards.

In addition, the data presented in Table 3 shows that the largest decrease in the number of attacks

concerns the ones backwards from 86 in the first minute to 32 in the play-off, while the number of attacks forwards increases from 29 made in the first minute to 37 made in the play-off.

It is obvious that the presented course of the fight was made by (in about 90%) the medallists of the Olympic Games and the athletes who took 5 to 7 places. This statistical picture of the fight is thus correlated with success in competitions at the highest level.

Reports of long-term observation of the Polish Championships comparing medallists and participants at lower levels also showed a significant correlation between the fight activity and tactical training with the result of the fight. The distribution of the fight in minutes presented in this report shows an entirely different image of the fight, represented by medallists and non-medalists of Polish Championships. This course of the fight is also different from that presented in this report [Sterkowicz *et al*. 2007]

Earlier studies on the judo competitions during the Olympic Games indicated the unique, in terms of organisation nature of the judo tournament played at the Olympic Games.

It does not mean that it should not be compared (in terms of sport results) to World Judo Championships for example.

The sport results in the Judo World Championship in 2011 at the heaviest category (+100kg) and results in the same category at the Olympics Games in 2012 in London are similar at 75%.

The Heinisch`s studies also indicate the significant effect changes in judo regulations for course of judo contest. But it was often introduced without consulting of judo circles and it was not the subject to the veto law [Heinisch 2005; Heinisch *et al*. 2010].

The collected data allows us to present the picture of a judo contest at the heaviest category (100 kg) after the latest changes of regulations:

The first minute of the fight is characterized by the highest number of attacks and the lowest indicator of Efficiency Ea, which suggests the so called recognition character of this minute.

1. The third minute of the fight is a characteristic point of the fight because after the initial decrease of the number of attacks a temporary increase appears which is connected with the increase of the Efficiency indicator Ea till the fourth minute. The third minute should undergo additional study and should be taken into account in training practice.
2. With the lapse of time the course of the fight changes because attacks backwards are dominant in the first minutes (with a tendency of decreasing number), in the last minute of the fight and in the play-off attacks forwards dominate (with a tendency of increasing number).

## Conclusions

1. The presented statistical course of the judo fight should be the basis of training analysis in order to create new, more precise pictures of the fight including all weight categories, used techniques, used tactical solutions.
2. The presented course of the fight should be compared to the one at the Polish Championships and confronted with the results of Polish champions at international championships.
3. The presented course of the fight should be compared to the one obtained before the significant changes of the judo regulations in order to check whether these changes of regulations influenced the picture of the fight in an significant and positive way.

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## Obraz walki judo w najcięższej kategorii (+100 kg) widziany z perspektywy ataków w pozycji stojącej, na podstawie Igrzysk Olimpijskich w Londynie 2012

**Słowa kluczowe:** walka judo, statystyka ataków w pozycji stojącej, igrzyska olimpijskie

**Streszczenie**

Celem prezentowanych badań było utworzenie statystycznego obraz walki judo w pozycji stojącej i przeanalizowanie zmian w jej obrazie w kolejnych minutach do wykorzystania w pracy trenerskiej.

Analiza wideo obejmowała wszystkie walki judo (z atakami w pozycji stojącej) w najcięższej kategorii wagowej (+100 kg) podczas Igrzysk Olimpijskich w Londynie 2012. Obliczono wskaźniki efektywności i skuteczności, które zastosowano do przedstawienia struktury walki w funkcji wykonywanej ilości ataków.

Zaobserwowano różne tendencje w liczbie ataków: spadek liczby ataków do tyłu, wzrost liczby ataków do przodu, zmiany w skutecznością ataku, co spowodowało zmieniający się w czasie obraz walki. Tworzenie nowego (po zmianie przepisów) przebiegu/obrazu walki judo daje dodatkowe możliwości poprawy pracy trenersko–szkoleniowej. Umożliwia również ocenę skuteczności wprowadzonych zmian w przepisach judo. Dodatkowo nowo utworzony obraz przebiegu walki powinien być porównany z obrazem uzyskanym w trakcie Mistrzostw Polski, oraz skonfrontowany z wynikami polskich mistrzów w zawodach międzynarodowych.