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The individual technical and tactical profile of a leading Polish judoka in the +100 kg weight category and his somatic composition in comparison to the world elite

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abstract

- Background** The aim of the study was to determine the individual tactical and technical profile of a leading Polish judoka from the heaviest weight category and the characteristic of his body composition in comparison to the world's elite in this category.
- Material/Methods** 92 fights carried out by the Polish athlete during national and international tournaments constituted material for the analysis of his technical and tactical profile. 12 judo competitors (1 Polish athlete and 11 competitors from 10 other countries) of the heaviest weight category at the top level of sports championship were subject to anthropometric measurements including 19 features. To evaluate the somatic types, Sheldon's method with Heath-Carter's modification was applied.
- Results** In his duels, the subject most efficiency performed throws from the *ashi waza* group, out of which he scored the most points and victories before the regular time using *osoto gari*. The throws from the *te waza* group proved to be the second most effective with the dominant throw being *seoi nage* executed from the knees. The subject's body height (199.0 cm) was higher than the mean for the control group (188.9 ±8.3 cm), and his body weight (113.0 kg) was lower than the mean of the world's leading athletes (119.4 ±18.2 kg). Mesomorphy dominated in the somatic type of the Polish athlete; however, in the control group its value was higher (6.0-8.3-1.5).
- Conclusions** To raise the efficiency of fights, the subject should increase the muscle mass and use his natural physical predispositions on the basis of the prospective analysis of its impact on the tactical and technical profile.
- Key words** Sports fight, efficiency in attack, physical predispositions

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INTRODUCTION

Determining elements of judo technique efficiently performed by a competitor during combat is an essential factor of the technical characteristics and evaluation of the efficiency of his technical-tactical actions [1, 2, 3]. Therefore, registering and analysing duels on the basis of which the efficacy of measures used by an athlete to gain a competitive advantage over his opponent and, consequently, to win is a common practice [4, 5, 6]. The need to conduct continuous observations also results from changes in the sports and judicial regulations that affect the efficiency of the techniques used in judo fights [7, 8]. In order to find the best training models, techniques which judo competitors at the highest level of sports championship execute the most efficiently in the fight have been analysed [9, 10, 11, 12].

For an overall assessment of the technical-tactical preparation (TTP) Adam [4] recommended indices defining versatility, activity, efficiency in attack and in defence and the athletes' efficiency with regard to their weight categories. Based on observations of conducted fights, Adam et al. [13] ventured to determine the individual tactical and technical profile of a female competitor at the highest level of sports championship, which in turn enabled finding the best solutions in the training process.

A judoka's fighting efficiency largely depends on his somatic composition, which distinguishes judo athletes of particular weight categories [14]. In the somatic types according to Sheldon's classification, a high proportion of mesomorphy, specifying the massiveness of body composition, and a low one of ectomorphy, describing the slenderness of body composition, are a common feature for all the best judokas [15, 16, 17]. However, in the heaviest category (+100 kg), extremely high values of mesomorphy are noted. In comparison to judokas of other weight categories, these athletes are also characterized by the highest level of endomorphy, defining their fat mass [14].

The relationships between the attacker's body composition and that of his opponent have a significant impact on the efficiency of the performed technical elements, which, in the context of the individual tactical and technical profile, seems to be one of the key factors determining the athlete's success in a judo fight [18, 19, 20].

The purpose of this study was to determine the individual technical and tactical profile of Poland's leading judoka in the heaviest weight category (+100 kg) and the characteristics of his somatic composition in comparison to the world's elite in this weight category.

MATERIAL AND METHODS

92 DVD-recorded fights of a Polish athlete (PZ) of the +100 kg weight category conducted during 13 national and 5 international tournaments in the two-year period (2011-2012) were analysed. Then all efficiently executed technical and tactical actions during these fights (for which he received judges' points) were registered on sheets in the form of graphic symbols which resembled the athlete's simplified body position while performing the action [2]. The calculation took into account the number of scored points, the number of attacks for which the judges awarded points, and the efficiency in attack (Sa):

$$Sa = 5 \times M + 7 \times M + 10 \times M/n \quad (1)$$

where M - the number of efficient attacks, n - number of analysed fights, 5, 7, 10 - point values of efficient attacks (*yuko*, *waza ari*, *ippon*).

To analyse the subject PZ's offensive action, the Kodokan Judo classification [21] was adopted. The spelling and naming of judo techniques were based on the Japanese-English judo dictionary [22].

PZ, with 14 years' training experience, body weight of 113.0 kg, body height of 199.0 cm and aged 25 years old, ranked (in 2012) among the top ten best athletes in Poland in the heaviest weight category (+100 kg), was anthropometrically measured. The comparison group (CG) was made of 11 judo athletes from 10 countries with the mean body weight of 119.4 ± 18.2 kg, body height of 188.9 ± 8.3 cm, age 26.0 ± 3.2 years and training experience of 14.6 ± 2.8 years, in 2012 ranked among the top 50 best athletes in the world in the heaviest weight category (+100 kg) (IJF World Ranking List). All anthropometric measurements were made once in 2012. In accordance with the requirements of the Declaration of Helsinki, the athletes subjected to measurements were informed of the research aim, the procedure methodology, a possibility to opt-out at any stage, and they expressed written consent to participate in the experiment. The study was approved by the Senate Committee on Ethics in Scientific Research at the Józef Piłsudski University of Physical Education in Warsaw.

Anthropometric measurements, made with Martin-Saller's technique [23], comprised: body weight, body height, sitting body height, height to the tibial point, thigh length, lower limbs length, skinfold on the arm, skinfold under the spatula, skinfold on the abdomen, skinfold above the wing of the ilium, skinfold on the shank, the arm circumference in flexion and tension, the shank circumference, the thigh circumference, the shoulder width, the pelvis width, the width of the head of the humerus and the femur and the ankle width. Measurements of the upper and the lower limbs, used to determine Sheldon's somatic types, were made according to Heath-Carter's method [24]. Skinfold measurements were made with a Harpenden calliper with a fixed measuring pressure of 10 g/mm^2 and the pressure surface of 90 mm^2 . Measurements were taken 3 times in the same place, and the result was a mean value separately for each assessed place. The percentage of body fat was estimated using Keys and Brożek's equation [25], having previously calculated the density body according to Piechaczek's formula [26]. Rohrer's index [27] was calculated according to the formula:

$$(R = \text{body weight (g)/body height (cm)}^3 \times 100) \quad (2)$$

All measurements were taken by the same person with over twenty years' experience in anthropometric measurements of professional athletes.

RESULTS

TACTICAL AND TECHNICAL PROFILE

For efficiently attacking his opponents, PZ most often received the highest scores from the judges, i.e. *ippon* ending the fight before the end of the regular time (Fig. 1). He won over 50.0% of the *ippon* scores performing foot throws (*ashi waza*), and 32.0% of the *ippon* scores were given him for performing hand throws (*te waza*). Elements of judo technique from other groups constituted a few percent in the number of awarded *ippon* scores. For his attacks, PZ also received *waza ari* and *yuko*, but less often than *ippon*.

Throws from the group of *ashi waza* (foot throws) had the largest share in the number of points earned for successfully carried out attacks (Fig. 2). Of them, the *osoto gari* (large outer reap) throw allowed a leading Polish judoka to gain the highest number of points. It amounted to 63.0% of all the points he earned for executing throws from this group. The *osoto gari* throw proved to be the most effective element of judo technique for PZ (Fig. 3). Clearly lesser efficiency in attack was reported for other throws from the group of *ashi waza*, such as *kosoto gari* or *deashi harai*.

The second after the *ashi waza* group in terms of the number of scored points was *te waza* (hand throws) (Fig. 2). Among throws from this group, *seoi nage* (shoulder throw) allowed PZ to score 77.0% of all points he earned by attacking with throws from the *te waza* group. The shoulder throw was also the second after the *osoto gari* throw in terms of the Sa value (Fig. 3). Other throws from this group were less efficient for PZ and clearly brought him fewer points.

The subject earned a significant number of points, amounting to 17.0% of the total score, for performing throws from the *sutemi waza* (sacrifice throws) group (Fig. 2), among which the *tani otoshi* throw let him gain 64.0% of points scored in this group.

Throws from the *koshi waza* (hip throws) group were characterised by lower Sa values (Fig. 3) and also had the smallest share in the total number of points (Fig. 2), just as judo techniques from the groups of *katame waza* (*shime-*, *osaekomi-* and *kansetsu waza*).

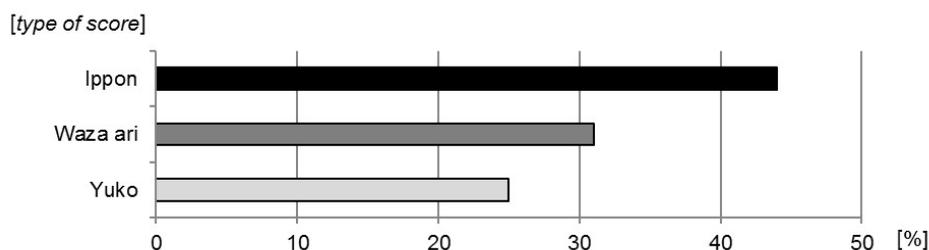


Fig. 1. Percentage distribution of scores obtained for efficient attacks

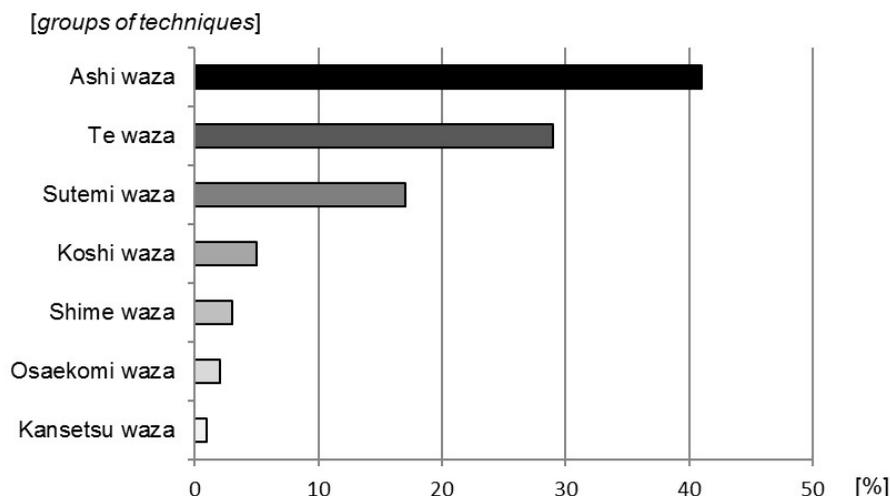


Fig. 2. Percentage distribution of points for efficiently executed attacks in particular groups of judo techniques

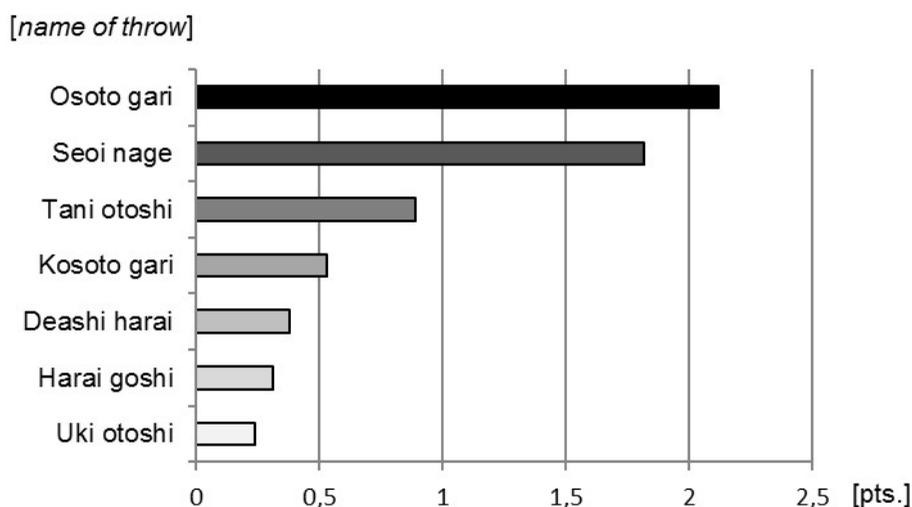


Fig. 3. The level of the efficiency in attack (Sa) - the most efficient techniques

THE SOMATIC COMPOSITION OF A POLISH LEADING JUDOKA FROM THE HEAVIEST WEIGHT CATEGORY (+100 KG) JUDO IN COMPARISON TO THE WORLD ELITE IN THIS CATEGORY

The best in the heaviest judo weight category (+100 kg), PZ stood out in comparison to the world elite in this category (Tab. 1) with a greater body height (5.3%), a greater sitting height (5.1%), the lower limbs length (5.5%) and the height measured to the tibial point (9.8%). In comparison to the CG, he had a lower body weight (5.4%), lower fat mass (8.5%) and a lower value of Rohrer's index (22.2%) (Tab. 2). In comparison to the world elite, PZ also manifested a narrower femoral head (7.1%), a narrower ankle (4.6%) and pelvis (5.7%) and smaller circumference of the thigh (5.1%) (Tab. 3 and 4).

Mesomorphy (8.9 ± 1.4), indicating high massiveness of body composition, was the dominant tissue component of the world's best judokas from the heaviest weight category (+100 kg) (Tab. 4). Similarly, a distinct advantage of mesomorphy over other components was reported in PZ; however, its value (8.3) was lower (6.7%) than the mean found in the CG. The value of endomorphy, the tissue component identifying the fat tissue level, was similar in the subject and in the CG. The recorded values of ectomorphy, a component that specifies slenderness, fluctuated around the lower levels; however, its higher value (114.3%) was found in PZ than in the CG.

Table 1. Somatic characteristics - length values

| Variable | Body height (cm) | Sitting body height (cm) | Lower limbs length (cm) | Thigh length (cm) | Height to the tibial point (cm) |
|----------------|------------------|--------------------------|-------------------------|-------------------|---------------------------------|
| PZ | 199.0 | 102.0 | 97.0 | 42.0 | 55.0 |
| CG | 188.9±8.3 | 97.0±4.4 | 91.9±5.1 | 41.8±4.1 | 50.1±1.9 |
| Difference (%) | 5.3 | 5.1 | 5.5 | 0.5 | 9.8 |

PZ - Polish athlete

CG - comparison group

Table 2. Somatic characteristics - body weight, the proportion of the fat tissue and the value of Rohrer's index

| Variable | Body weight (kg) | Fat tissue (%) | Fat mass (kg) | Fat-free (kg) | Rohrer's index |
|----------------|------------------|----------------|---------------|---------------|----------------|
| PZ | 113.0 | 22.8 | 25.8 | 87.2 | 1.4 |
| CG | 119.4±18.2 | 23.6±4.5 | 28.2±1.3 | 91.2±4.1 | 1.8±0.3 |
| Difference (%) | -5.4 | -0.8 | -8.5 | -4.4 | -22.2 |

PZ - Polish athlete

CG - comparison group

Table 3. Somatic characteristics - the width bone heads in the limbs and the width of the shoulders and the pelvis

| Variable | Humeral head width (cm) | Femoral head width (cm) | Ankle width (cm) | Shoulder width (cm) | Pelvis width (cm) |
|----------------|-------------------------|-------------------------|------------------|---------------------|-------------------|
| PZ | 7.9 | 10.5 | 8.2 | 43.5 | 29.8 |
| CG | 8.2±0.5 | 11.3±0.7 | 8.6±0.4 | 44.4±2.2 | 31.6±2.4 |
| Difference (%) | -3.7 | -7.1 | -4.6 | -2.0 | -5.7 |

PZ - Polish athlete

CG - comparison group

Table 4. Somatic characteristics - limb circumferences and values of Sheldon's tissue components in Heath and Carter' modification

| Variable | Arm circumference in tension (cm) | Shank circumference (cm) | Thigh circumference (cm) | Endo-morphy | Meso-morphy | Ecto-morphy |
|----------------|-----------------------------------|--------------------------|--------------------------|-------------|-------------|-------------|
| PZ | 43.0 | 44.0 | 65.5 | 6.0 | 8.3 | 1.5 |
| CG | 44.0 ±3.7 | 45.0 ±3.4 | 69.0 ±4.8 | 5.9 ±2.0 | 8.9 ±1.4 | 0.7 ±0.2 |
| Difference (%) | -2.3 | -2.2 | -5.1 | 1.7 | -6.7 | 114.3 |

PZ - Polish athlete

CG - comparison group

DISCUSSION

The most efficient and the most commonly executed by PZ throw was the large outer reap (*osoto gari*), belonging to the group of foot throws (*ashi waza*). An analysis of fights conducted in the open category at the All-Japan Judo Championships (2003-2012) by Adam et al. [28] also proved that the heaviest athletes by far the most efficiently performed throws from the *ashi waza* group. As the most important, the authors enumerated 5 throws: *uchi mata*, *ouchi gari*, *osoto gai*, *kouchi gari* and *kouchi gake*. Similarly, analysing fights in the heaviest weight category (+100 kg) in London 2012, Pujszo et al. [29] confirmed the importance of the efficiency of throws from the group of *ashi waza* in this weight category. Also Boguszewski [30] showed that athletes of the heaviest weight categories most frequently tried to attack using throws from the *ashi waza* group. At the same time, other authors indicate taller athletes' predispositions to perform the *osoto gari* throw during a fight with shorter opponents, especially in the heaviest weight categories [19, 20, 31, 32].

The heaviest judo competitors by far less frequently performed hand throws (*te waza*), which dominated among athletes of light categories [30]. Therefore, it may seem surprising that the second technique with which PZ also won the highest number of points was the shoulder throw (*seoi nage*). This is a very popular and often performed throw in judo [4, 33]. However, unlike *osoto gari*, the *seoi nage* throw was the most efficiently executed by the shortest athletes in their weight categories, who also had higher values mesomorphy than their opponents [18, 19, 31, 32]. This throw requires an attacker to place his centre of gravity below the opponent's centre of gravity. In such a situation, the shorter judoka is able to do it faster and more efficiently than his opponent (18, 20).

The *seoi nage* throw has many varieties. Due to his body height, PZ adjusted this throw to his somatic conditions and executed it from his knees, which consequently turned out to be the right decision. Owing to this solution, he was able to quickly go down below his opponent's centre of gravity, between his feet and at the same time take him on his back and throw by pulling his hands down [18]. It is worth noting that the recent amendments to the regulations of judo fight forced a straight posture from the competitors [8, 34]. The aim of such changes was to increase the attractiveness and showmanship of judo fighting. Presumably, an opponent's upright posture greatly facilitated the subject's efficient attacks, which were also mostly evaluated with the *ippon* score, giving him a spectacular victory before the end of the regular fight time.

PZ most efficiently performed throws from the groups of *ashi waza*, *te waza*, and *sutemi waza*, while attacks from the group of *koshi waza* throws and actions on the ground were the least efficient and the least performed by him. Especially low efficiency of holds (*katame waza*) and pinning (*osaekomi*) may raise a concern because many great heavy-weight judokas are characterised by very high efficiency of these elements of judo fight [35, 36].

A leading judoka from the heaviest weight category, PZ was clearly taller (199.0 cm) than the mean found in the comparison group (188.9 ± 8.3 cm). Shorter body height than in the subject, and similar to that of the CG, was also reported in the Korean (189.0 ± 1.5 cm) [37], te Serbian (192.4 ± 6.0 cm) [38] and Brazilian (192.5 ± 0.7 cm) [39] elite judokas in the +100 kg category. PZ's taller body height might have facilitated holding a shorter opponent's judogi collar at the back behind his head. This, in turn, can make it easier for a taller athlete to execute the *osoto gari* throw [18, 19].

With a taller body the leading Polish competitor had a lower body mass in relation to the CG, and he was also clearly lighter than the Korean elite (132.2 ± 1.6 kg) [37] and a little lighter than the Serbian elite judokas (116.5 ± 8.4 kg) [38] in the +100 kg category. In PZ's somatic type (endomorph - 6.0; mesomorph - 8.3; ectomorph - 1.5), as well as in the CG somatotypes (5.9-8.9-0.7), mesomorphy clearly dominated. Similar results (7.2-8.6-0.1) were obtained by Franchini et al. [39] examining elite Brazilian judokas in the +100 kg category. Mesomorphy, which specifies the massiveness of the body composition is a major tissue component in Sheldon's somatic types in judokas and wrestlers of all weight categories [40, 41]. This is an effect of the selection process, genetic predispositions and adapting the body to often extreme loads that occur in combat sports [42]. The heads of these athletes' bones to which strong muscles with large circumferences are attached are well prepared for the specificity of sports training and combat. The muscles, in turn, have a large cross-section surface area determining the level of strength and the dynamics of the executed attacks [43]. Judokas and wrestlers of the heaviest weight categories have extremely high values of mesomorphy and simultaneously a high level of endomorphy testifying to their substantial adiposity, which was also found in this study [14, 40]. However, with a similar to the comparison group percentage of body fat, its mass was lower by 8.5% in the subject. Although PZ had very massive physique, as proved by the high level of mesomorphy, its value was lower than that recorded in the world elite. His fat-free mass was also lower by 4.4%. In comparison to them, as well as to Brazilian judokas [39], he was also slimmer, as indicated by the ectomorphy level.

With longer legs, the length of his femur was found to be similar to the control group. Consequently, his height measured to the tibial point was greater by 9.8% compared to the control group, and this can condition his worse defensive capabilities, which were not analysed in this study, but which should be more focussed on in improving defensive actions [18].

CONCLUSIONS

1. The individual profile of technical-tactical preparation of the leading Polish judoka in the heavy-weight category was based on efficient execution of techniques from the *ashi waza* group, such as *osoto gari* and *kosoto gari* and from the *te waza* group, among which the *seoi nage* throw executed from the knees dominated. Also the *tani otoshi* throw, belonging to the *yoko sutemi waza* group had substantial contribution. For efficiently executed attacks PZ most often received the *ippon* score and less often *waza ari* and *yuko*. Techniques from the group of holds (*katame waza*) were the least important of all groups.
2. A leading Polish athlete of the heaviest weight category (+100 kg), in comparison to the world elite in this category, was characterised by less massive body composition, greater height and lower weight.
3. To catch up with the world elite, PZ should increase his body weight through development of the muscle tissue and, simultaneously, take into account the impact of changes in the somatic composition on the efficiency of execution of *tokui waza* (his favorite technique).

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