

# Sports result vs. general physical fitness level of junior taekwondo athletes

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## Summary

**Introduction.** The aim of the study was to identify correlations between general physical fitness (independent variable) and sports result (dependent variable) of junior taekwondo athletes.

**Material and methods.** Of all the subjects  $n = 104$  there were 62 male and 42 female juniors at the level of at least the 6<sup>th</sup> kup. The research was conducted with the use of the International Physical Fitness Test (IPFT). A sports result was defined by the place won at Polish Junior Championships in 10 weight classes. The analysis regarding the significance of differences between groups was done by means of one-way ANOVA variance.

**Results and Conclusions.** It was observed that a sports result in female junior taekwondo athletes was conditioned by the power of lower extremities, strength and endurance. In the case of males, however, it was not clearly determined what a sports result depended upon.

## Introduction

Today it is believed that the Eastern martial arts are an element of global culture [1]. They are practised all over the world for various reasons: to acquire self-defence skills, for recreational and health purposes or to get ready for an effective sports competition [2].

The analysis of national and foreign literature points to a wide variety of tools applied to assess general physical fitness of competitors practising combat sports, i.e. judo, wrestling, boxing, taekwondo, kickboxing or karate.

Sadowski et al. [3,4] assessed the level of coordination motor abilities (CMA) in taekwondo competitors, kick boxers and wrestlers at various levels of sports advancement and found that a higher sports level corresponded with a higher level of coordination motor abilities.

While studying balance, flexibility as well as strength and muscle endurance in female and male taekwondo athletes, Douris [5] observed that regardless of age and gender, mean values of those measurements are higher than among ordinary humans, just as it is in other combat sports [6]. For taekwondo competitors flexibility plays an essential role in as it enables them to perform high kicks on the head, for which one can get a lot of points in the system of sports fights [7]. Marković et al. [8] proved that female competitors achieving the highest sports results demonstrated higher maximum acceleration, higher ventilatory threshold with lower heart rate, greater explosive power, higher maximum anaerobic power and better agility.

Cho [9] found that muscle strength, explosive power, endurance, reaction time and the amount of subcutaneous adipose tissue play a key role in achieving success in taekwondo.

Starosta and Tracewski [10] analysed the level of motor abilities in top Greco-Roman and freestyle wrestlers. They observed a positive correlation between the levels of motor fitness and sports achievements. The research also defined the levels of motor (conditioning and coordination) abilities at different levels of sports preparation. Sterkowicz [11] assessed selected features of karate athletes. It turned out that elite competitors manifested high levels of physical fitness. World Championship medallists differed significantly from those who lost their first fights.

The research into physical fitness and sports results of taekwondo athletes was carried out by Bujak [12,13,14], who noted that the best competitors demonstrated smaller body mass and higher levels of fitness preparation.

The International Physical Fitness Test (IPFT) is the most common test applied to evaluate general physical fitness in taekwondo. Its advantages include easy execution, reliability, objectivity, normativeness, economy and accuracy [15]. The choice of the test was determined by the requirements of the Ministry of Sport and Tourism (MST) as a tool endorsing the selection of competitors to regional teams of juniors. Such athletes are required to obtain at least medium or high fitness levels (according to the MST grading scale).

The aim of the study was to characterise motor fitness of taekwondo athletes taking into consideration the level of sports results and to determine a motor profile.

## Material and methods

The study included 104 competitors (42 girls and 62 boys). The subjects were 15-17 years old and they were at the level of at least the 6th kup. By participating in two qualifying tournaments all of them qualified for the Polish Junior Championships in Taekwondo in 2007. The athletes competed in 10 weight classes according to gender.

The International Physical Fitness Test (IPFT) was carried out in standard conditions by one research team during a national training camp in the Olympic Sports Centre in Spala in 2007. Rough data were converted to points and compared with the norms of physical fitness, thus assigning the subjects to a proper fitness group.

The level of the sports result was defined by the place won at the Polish Taekwondo Championships, as stated in the final bulletin of the Polish Taekwondo Federation.

## Results

In all the tests the examined female taekwondo competitors scored above the national average of 50 pts (Table 1). They performed best in the test of strength endurance of abdominal muscles (T 7) and the power of lower extremities (T 2), while in the case of flexibility (T 8) they obtained the worst results.

The differences between female juniors and the national average turned out to be considerable (11-20%) in five cases and big in the remaining ones (21-50%). The female subjects under investigation ought to be considered as people with high levels of fitness. The sum of all tests was above 481 pts.

In a research questionnaire the following IPFT tests were selected by coaches as having a significant influence on a sports result in taekwondo: T 1 (speed), T 2 (power of lower extremities), T 3 (running endurance) and T 6 (agility). The scores for those abilities were at the level of about 63 pts, i.e. above the lower limit for sportspeople as defined by Ulatowski [16].

Table 1. Mean values (pts) of IPFT tests in female taekwondo juniors and untrained girls

Subjects	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	Σ (pts)
Female juniors	64	66	59	61	59	61	69	57	496
Untrained girls	50	50	50	50	50	50	50	50	400
Difference	22%	24%	18%	18%	15%	18%	28%	12%	19%

Key: T1 – 50m run; T2 – standing long jump; T3 – endurance run; T4 – hand dynamometry; T5 – arm hang; T6 – 4 x 10m run; T7 – 30-sec sit-ups; T8 – trunk flexion.

Table 2. Mean values (pts) of IPFT tests in male taekwondo juniors and untrained boys

Subjects	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	Σ (pts)
Male juniors	60	60	59	54	53	53	69	58	468
Untrained boys	50	50	50	50	50	50	49	50	400
Difference	17%	17%	18%	7%	9%	6%	28%	14%	15%

Key: T1 – 50m run; T2 – standing long jump; T3 – endurance run; T4 – hand dynamometry; T5 – pull-ups; T6 – 4 x 10m run; T7 – 30-sec sit-ups; T8 – trunk flexion.

Table 3. Mean values of IPFT achieved by comparative groups

Groups of subjects	Mean values of IPFT (pts)		Difference
	girls	Boys	
Gold medallists	526	469	11%
Silver medallists	524	423	19%
Bronze medallists	488	464	5%
Non-medallists (places from 5th to 8th)	449	447	0.5%

Table 4. Mean values of IPFT results of female taekwondo athletes

Variables	Female juniors				F	p
	medallists	SD	non-medallists	SD		
Body height	167.5	7.4	165.9	4.8	0.7	
Body mass	58.3	9.5	60.1	9.0	0.4	
T 1 (locomotive speed)	7.6	0.6	8.0	0.8	3.4	
T 2 (power of lower extremities)	210.5	16.7	192.1	19.0	11.4	**
T 3 (running endurance)	198.1	16.5	222.1	44.1	5.9	*
T 4 (hand strength)	36.7	14.5	31.7	5.0	2.2	
T 5 (power of upper extremities)	21.3	15.4	11.9	12.8	4.7	*
T 6 (agility)	11.1	0.7	11.7	1.1	4.3	*
T 7 (strength endurance of abdominal muscles)	33.9	5.3	26.3	5.1	23.1	*
T 8 (flexibility)	14.6	5.3	14.3	4.1	0.1	

p – differences significant at the level of < \*0.05, \*\*0.01, \*\*\*0.001  
F – the ratio of inter-group variance to intra-group variance.

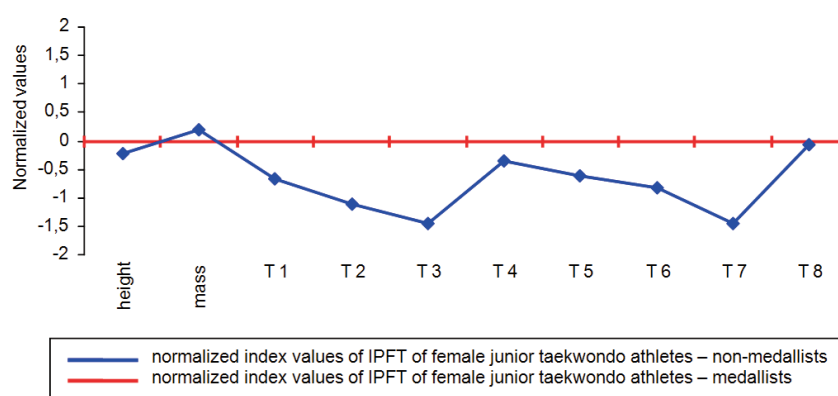


Fig. 1. Normalized index values characterising examined female junior taekwondo athletes

Among the studied male juniors ( $n = 62$ ) the examined motor abilities were at a lower level than in the case of female juniors ( $\Sigma = 468$  pts) but at a higher level than the national average for Polish youth (Table 2).

Male juniors performed best in strength endurance of abdominal muscles (69 pts), which dominated in the profile of fitness preparation. The smallest differences (6-9%) were observed among untrained peers in hand and arm strength as well as agility.

Taking coaches' opinions about the most crucial motor abilities into consideration, male juniors demonstrated weak and medium levels of preparation.

The division of the examined female juniors according to the criterion of competition efficacy made it possible to define motor profiles of gold, silver and bronze medallists of the Polish Championships.

As for the profile of motor preparation in the group of gold medallists, the following abilities prevailed: strength endurance of abdominal muscles, power of lower extremities and hand

strength. The points given for the best result differed (65-100 pts), yet the average of eight tests (66 pts) is above the lower limit for sportspeople [16]. This group demonstrated the highest levels of technical skills.

The dominant abilities in the group of silver medallists were strength endurance of abdominal muscles and hand strength. Except for technical skills, the other indices were similar to those in the group of the best competitors.

As far as bronze medallists are concerned, the dominant abilities were strength endurance of abdominal muscles, power of lower extremities and hand strength. The level of the best results in eight tests was lower than in the case of female finalists of the Polish Championships. The same goes for the level of technical skills.

As for male gold medallists, the highest index values ranged from 64 to 99 points. Strength endurance of abdominal muscles and hand strength dominated in their motor profile.

Silver medallists manifested lower levels of motor and technical preparation than gold medallists. The third group,

Table 5. Mean normalized values of IPFT results of male taekwondo athletes

Variables	Male juniors				F	p
	medallists	x ± SD	non-medallists	x ± SD		
Body height	168.0	6.7	177.4	5.8	31.3	*
Body mass	53.6	5.0	67.8	6.8	68.3	*
T 1 (locomotive speed)	7.2	0.5	6.9	0.4	6.2	*
T 2 (power of lower extremities)	238.5	27.9	235.1	19.6	0.3	
T 3 (running endurance)	220.5	21.2	204.4	13.3	12.8	***
T 4 (hand strength)	46.6	5.5	49.7	6.9	3.1	
T 5 (power of upper extremities)	5.8	4.3	5.7	3.2	0.01	
T 6 (agility)	11.0	1.0	10.9	0.5	0.2	
T 7 (strength endurance of abdominal muscles)	35.1	4.3	33.8	3.9	1.3	
T 8 (flexibility)	13.1	5.8	12.9	5.3	0.01	

p – differences significant at the level of < \*0.05, \*\*0.01, \*\*\*0.001  
F – the ratio of inter-group variance to intra-group variance.

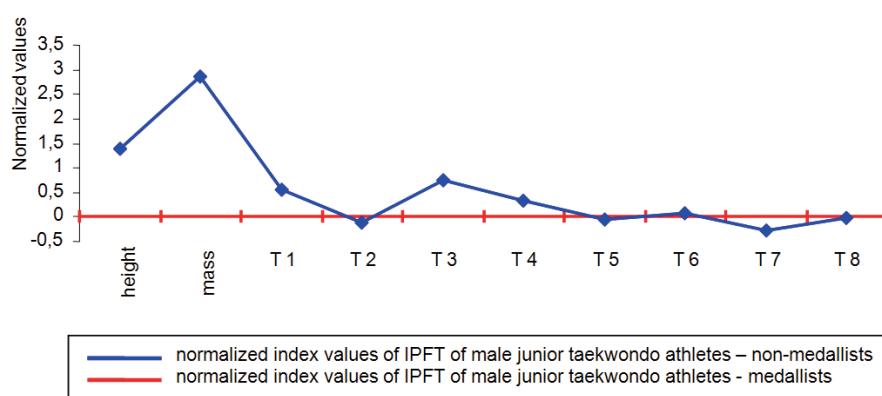


Fig. 2. Normalized index values characterising examined male junior taekwondo athletes

however, demonstrated higher levels of indices than silver medallists. The dominant abilities were the same as in the case of the best competitors.

While comparing female and male competitors from particular groups (Table 3), we can observe that female juniors demonstrate much higher levels than their male counterparts, particularly in the group of silver medallists (by 19%). In turn, the groups of female and male juniors with the weakest results do not differ in the levels of fitness preparation.

Rough index values of particular tests (T) – Table 4 – were converted to the mean value of the group of female medallists, which made it possible to analyse the results on the same scale [17]. The analysis regarding the significance of differences between groups was done by means of one-way ANOVA variance [18].

It turned out that the group of female taekwondo athletes with the weakest results differed considerably from their peers from better groups in the level of endurance preparation (T 3 and T 7). However, there were only slight differences in flexibility and somatic build (Fig. 1).

As for male juniors, the differences in index values between medallists and non-medallists were of a different character (Table 5).

The greatest (statistically significant) differences occurred in somatic build, speed and running endurance (Fig. 2). The remaining indices were at a similar level.

## Discussion

Not much research enhancing a training process in taekwondo has been done even though it is an Olympic sport. Due to the fact that it is a full-contact combat sport, a lot of analyses [19,20,21,22,23] focus on injuries. Biochemical, physiological and biomechanical aspects of training and competition are also the subjects of a lot of studies [24,25,26]. It seems that motor preparation and its profile depending on sports advancement and somatic build are equally important aspects in getting to know the specificity of the sport.

The comparison of physical fitness of taekwondo athletes (n = 104) revealed that they demonstrated levels higher than

the national average [27] by approximately 17%, which was within the limits for sportspeople [16]. Although female juniors manifested higher levels of motor preparation than males, their motor profile was similar.

The dominating features included the strength endurance of abdominal muscles (69 pts) and the power of lower extremities (60-66 pts). Similar results were obtained by Bujak [14], who examined non-Olympic taekwondo athletes. Taking into account the specificity of technical and tactical actions in sports competition [28], such motor orientation seems to be well-grounded.

The comparison of the subjects with regard to sports results provided more thorough data concerning motor preparation. Amongst female juniors, gold medallists did not differ from silver medallists. However, those two groups scored much better in all the analysed indices than bronze medallists. The greatest differences were registered in the levels of technical preparation (by 30%) and a motor ability for which one could get the highest number of points (by 13%). Taking into consideration the dominant motor ability in the profile of fitness preparation, the group of female silver medallists turned out to be the least diverse.

As far as male juniors are concerned, the analyses revealed a different picture of motor fitness. Gold medallists were prepared better than the others, whereas the differences between silver and bronze medallists were slight. Bronze medallists manifested higher levels of motor preparation than runners-up. In order to qualify for the finals, one had to demonstrate high levels of other components. Nevertheless, while competing with the best it is difficult to expect any success without proper "fitness foundation". The motor profile concentrated on strength endurance of abdominal muscles (T 7) and hand strength (T 4), which comes as a surprise given that the use of hand strikes in taekwondo is marginal. Bronze medallists demonstrated significant levels of the power of lower extremities.

If we take into account coaches' opinions regarding dominant motor abilities in the profile of fitness preparation, only the significance of the power of lower extremities was borne out in the study. Therefore, a question arises for coaches, by pointing to locomotive speed, power of lower extremities, run-

ning endurance and agility as the dominant abilities in motor preparation. Do they simply make incorrect judgements?

The comparison of motor preparation with regard to gender revealed much higher levels among girls, who also perform better in the international arena.

The conversion of research results to the mean value amongst female medallists provided a lot of cognitive and applicable suggestions. In order to compete successfully with the best, it is essential that female juniors should improve the levels of four motor abilities that were significantly different among the subjects. These suggestions are parallel with the findings of Kazemi et al. [29].

As for male juniors, it is difficult to define the factors of sports success clearly. Perhaps the body mass of competitors who did not achieve any success was the loss factor. Among gold medallists the winner in the weight class of 45 kg differed significantly from the others in the levels of motor abilities. Only six athletes competed in this weight class (four competitors did not participate in the finals due to injuries received at Polish Junior Championship qualifications). Therefore, the lack of strong competition enabled a mediocre athlete to win.

## Conclusions

The analysis of research results led to the following conclusions:

1. The participants of the Polish Junior Championships in taekwondo demonstrated higher levels of physical fitness than the national average for Polish youth.
2. Strength endurance of abdominal muscles dominated in the profile of motor training.
3. Taking into consideration sexual dimorphism, female juniors manifested higher levels of physical fitness.
4. Four abilities are dominant in the profile of motor training: power of lower extremities, running endurance, agility and strength endurance of abdominal muscles.
5. No dominant motor abilities were observed in male juniors.
6. In order to determine leading motor abilities among male juniors it is necessary to carry out more extensive research including the best competitors.
7. The knowledge possessed by taekwondo coaches is not reflected in adaptive effects of their athletes.

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