

# Physical preparation of female judo competitors at selected stages of long-standing sports training

## Authors' Contribution:

- A** Study Design
- B** Data Collection
- C** Statistical Analysis
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Władysław Jagiełło<sup>ABCDE</sup>, Wolska Beata<sup>ABCDE</sup>, Smulski Walery<sup>ABCDE</sup>

Academy of Physical Education and Sport in Gdansk, Poland

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## Abstract

### Background:

It is currently assumed in sports theory and practice that general and special physical preparation is an indispensable condition for the development of motor skills as one of the most important factors determining the effectiveness of athletes' training and competition activity. Therefore, the aim of the study is an analysis of correlative connections between indices of judo competitors' general and special physical preparation at various stages of long-standing training.

### Material/Methods:

The paper presents the results of studies on general and special physical preparation of three groups of female judo competitors: eleven Polish national team representatives in the senior category (the stage of maximal realisation of individual capabilities), fifteen Polish national team and Pomerania Province team representatives in the category of juniors (the stage of directed training), and fourteen Pomerania Province team representatives in the category of sub-juniors and younger juniors (the stage of general training). General physical preparation was assessed on the basis of the International Physical Fitness Test (IPFT), and the special one on the basis of Special Judo Fitness Test (SJFT).

### Results:

Competitors from all groups are characterised by high IPFT indices. The studied group of seniors exceed 16–18-year-old competitors in a statistically significant way, who in turn exceed the 13–15-year-old ones as far as results obtained in the SJFT test are concerned. Highly-qualified competitors are characterised by more expressed and direct interdependence between the IPFT and SJFT test indices in comparison with the studied groups of 16–18-year-old and 13–15-year-old competitors.

### Conclusions:

With increase in judo competitors' sports level, the number and the level of these mutual relations also increases.

### Key words:

judo • women • energy system • factor analysis • stage of directed training

### Author's address:

Jagiello Władysław, Academy of Physical Education and Sport in Gdańsk, Wiejska 1 Str., 80-336 Gdańsk, Poland, e-mail: wjagiello1@wp.pl

## BACKGROUND

It is currently assumed in sports theory and practice that general and special physical preparation is an indispensable condition for the development of motor skills as one of the most important factors determining the effectiveness of athletes' training and competition activity [1,2].

General physical preparation aims at increasing the functional potential of the organism, its comprehensive development and mastering various motor habits. On the other hand, special physical preparation aims

at developing motor skills in close connection with the requirements specified in a particular sports discipline.

Despite the fact in the process of training the perfection of one specific component of the preparation in its pure form does not occur, in order to better understand the content of physical preparation, it was assumed that the directed practising of particular qualitative aspects of motor activity – strength, speed, endurance, flexibility and coordination skills – takes place. Such a division is contractual since all motor skills are closely interrelated, and in the process of muscle activity they occur in

**Stage of directed training** – one of stages of long-standing sports training. The basic tasks of this stage are: improving health status and directed formation of physical development of young athletes, creating a solid basis for technical preparation which encompasses mastering a wide range of motor skills and habits corresponding with a selected discipline and well as consolidating the interest in systematic training. In judo it falls for the age of 15–19 and is characterised by a significant increase in directed and special exercises in comparison to the stage of general training.

**The energy system** (in an organism) – is the aggregate (total) of the biochemical mechanisms (anaerobic and anaerobic processes) that results in the recovery of ATP in organism.

**Judo, women** – an Olympic sports discipline practiced by women.

**Factor analysis** – a statistical method of result analysis.

**Table 1.** Age and somatic indices of female judo competitors in three studied groups (statistically significant differences at  $p < 0.05$  with reference to: 1\* – for the senior group, 2\* – for the group of 16–18-year-old competitors, 3\* – for the 13–15-year-old competitors).

Studied groups	Statistics	Indices										
		Experience	Age / years/	Height /cm/	Weight /kg/	BMI	FAT /kg/	FAT /%/	FFM /kg/	FFM /%/	TBW /kg/	TBW /%/
Group of seniors (n=11)	M	14.2	25.2	168.2	65.6	23.1	13.6	19.9	52.1	80.1	38.2	58.7
	SD	4.0	3.7	5.5	12.1	3.2	6.6	5.4	6.2	5.4	4.5	4.0
	P	2*,3*	2*,3*		3*	3*			3*		3*	
16–18-year-old group (n=15)	M	7.2	16.8	165.3	64.8	23.6	15.4	23.3	49.4	76.7	36.1	56.1
	SD	2.5	0.7	7.8	11.2	2.9	5.4	5.5	7.4	5.5	5.4	4.0
	p	1*	1*,3*		3*	3*			3*		3*	
13–15 year-old group (n=14)	M	5.5	13.9	164.1	54.4	20.2	12.2	22.0	42.1	78.0	30.8	57.6
	SD	1.9	1.1	7.4	6.9	2.1	4.6	5.9	3.9	5.9	2.8	5.1
	p	1*	1*,2*		1*,2*	1*,2*			1*,2*		1*,2*	

a complex dialectical unity [3,4]. Therefore, also distinguishing between general and special physical preparation should be treated as contractual and they should be considered as various aspects of the same process which in reality are dependent on each other. During long-standing sports training the unity and close interdependence of these two types of fitness preparation is manifested in all periods of a yearly cycle. A proper relation of the general and special preparation (which takes into consideration an athlete's age, level of preparation, individual characteristics, the stage and training experience) substantially determines the effectiveness of the whole training process [5].

It is known that the content and the proportions of an athlete's general and special physical preparation are different at different stages of long-standing training (the general, directed and special ones). While at the first stage general preparation is the most widely applied, then with increase in specialisation the increase in significance of special preparation corresponding with the profile of a particular sports discipline takes place. At the same time the principal unity of an athlete's general and special physical preparation does not lose in significance, regardless of changing proportions [2]. For these reasons it is of specific theoretical and practical significance to settle the following issue – to which extent are the indices of athletes' general and special physical preparation interrelated at various stages of their long-standing training [6].

Therefore, the aim of the study is an analysis of correlative connections between indices of judo competitors' general and special physical preparation at various stages of long-standing training.

## MATERIAL AND METHODS

In the study carried out at the end of the 2007 preparatory period three groups of female judo competitors took

part. The first group comprised top-class athletes belonging to the Olympic and the National Teams or being their immediate back-up (n=11) – the special training stage (a phase of maximal realisation of individual potential). The mean age of the subjects from this group was  $25.2 \pm 3.7$  years and the training experience  $14.2 \pm 4.0$  years.

The second group was made up of 15 athletes – Polish National Team and the Pomeranian Province Team representatives aged 16–18 (the stage of directed training). The competitors' mean age was  $16.8 \pm 0.7$  years and the training experience  $7.2 \pm 2.5$  years.

The third group comprised 14 sub-juniors and younger juniors, representatives of the Pomeranian Province Team (the stage of general training). Their mean age was  $13.9 \pm 1.1$  years and the training experience  $5.5 \pm 1.9$  years. The subjects' characteristics are presented in Table 1. The study was carried out at the Academy of Physical Education and Sport in Gdańsk (Poland), among other units in the Athletes' Functional Diagnostics Laboratory.

In order to determine the somatic characteristics of athletes from the three studied groups, measurements of their body height and indices characterising their mass and body components: body mass index (BMI), fat mass content (FATkg and FAT%), fat-free mass content (FFMkg) and water (TBWkg) in the organism were taken. To do this the "Body Composition Analyser" was used (Tanita Body Composition Analyzer TYPE TBF-410 MA III Tanita Corporation 14-2, I-chome, Maeno-cho, Itabashi-ku Tokyo, Japan).

The results of the International Physical Fitness Test [7], which has a wide application in a judoka's training process, were used to assess the athletes' general physical preparation. These were indices obtained in the following tests: 50-meter sprint (s), standing long jump (cm),

800-meter run, grip strength (kg), flexed arm hanging (s), 4×10-meter shuttle run (s), 30-second sit-up (number of times), and trunk bend forward (cm) as well as the integral index of IPFT general physical fitness (sum of points). In consistence with authors' recommendation, MTSF was carried out on two days. The assessment of fitness in attempts one to three was performed on the first day. Attempts from four to eight were carried out on the second day.

For the assessment of the athletes' special physical preparation, the indices obtained while testing by means of the Special Judo Fitness Test SJFT were applied [8]. SJFT is composed of three periods of work: 15 s (series A), 30 s (series B), 30 s (series C) separated by 10 s breaks. During each effort the tested athlete's task was to perform the greatest number of seoi-nage throws, which was made with two exercise partners (uke). In consistence with the recommendations of the test author, the uke were selected from the same weight category and they were of similar height. Immediately on completion of series C and after 1 min since the test completion HR measurement was taken [bt·min<sup>-1</sup>]. To measure the frequency of the heart rate, a sports tester "Polar Sport Tester" was used (POLAR 810 I™ Polar Electro Oy, Finland, Model #1903020). A film version of the test was prepared in the European Centre of Training for Judo Coaches at the University of Bath (England) [8].

During the test the following were noted down: the number of throws in series A, the number of throws in series B, the number of throws in series C, the sum of throws in all series, HR immediately after the effort [bt·min<sup>-1</sup>], HR after 1 min. since the completion of the effort [bt·min<sup>-1</sup>].

On the basis of the obtained results, the index was calculated:

$$I_{\text{SJFT}} = \frac{\text{HR after effort [bt·min}^{-1}\text{]} + \text{HR after 1 min. since effort compl. [bt·min}^{-1}\text{]}}{\text{Sum of throws (series A + series B +series C)}}$$

The test results were then subject to basic statistical analysis defining the arithmetic mean (M), standard deviation (SD), mean differences significance (p), and the correlation coefficient (r) using standard computer analytic software "STATISTICA 6.0 PL".

## RESULTS OF THE STUDY

The data presented in Table 1 proves a lack of significant differences in mean indices of body height between athletes of the three studied groups (p<0.05). Differences between mean group indices of both body mass of seniors

and 16–18-year-old competitors and such indices of its components as BMI, FFM<sub>kg</sub> and TBW<sub>kg</sub> turned out to be statistically insignificant. However, as could be expected, in the group of 13–15-year-old competitors the mean values of the given indices proved significantly lower in comparison with the analogous indices of judo athletes from the two former groups (p<0.05). The difference between the mean group indices of the fat body mass component (FAT<sub>kg</sub> and FAT%), the percentage composition of fat-free body mass (FFM<sub>%</sub>) and the percentage composition of water in the organism (TBW<sub>%</sub>), proved statistically insignificant in all three studied groups (p<0.05).

The results of studies on judo athletes' general physical preparation at various stages of long-standing sports training are presented in Table 2.

The statistical analysis of the study results did not reveal any significant differences between the studied groups in mean values of the 50-meter sprint. Also the differences between the results in the 800-meter run, the 4×10-meter shuttle run, sit-ups and the trunk bend forward turned out to be insignificant.

Senior group competitors exceeded the 16–18-year-old and 13–15-year-old ones in the results obtained in standing long jump (p<0.05). However, between the latter two groups this difference was not statistically significant. A similar situation took place in the case of results obtained the dynamometer grip test and the indices reflecting the results in the flexed arm hang test.

Together with absolute values of the IPFT test indices, Table 2 presents also their point values. As follows from the obtained data, the sum of all points (the integral index of general physical preparation) in the group of seniors amounted to 534.4 pts, and the group of 16–18-year-old and 13–15-year-old competitors 490.6 and 513.0 pts, respectively. In consistence with (normative) IPFT point ranges, the sums of points determined for all studied groups are assessed as indices of high general physical preparation.

The results diagnosing the level of special physical preparation in the three groups of judo athletes obtained by means of the SJFT test [9] are presented in Table 3.

As follows from the obtained data (Table 3), the differences between the three groups of subjects proved statistically insignificant as far as the number of throws in the first series of the test is concerned. Subjects from the senior group exceeded 16–18-year-old competitors (p<0.05) as far as the number of throws in series B and C are concerned and the competitors from the latter two groups in the sum of all throws performed in the three

**Table 2.** Indices of general physical preparation of female judo competitors in three studied groups (statistically significant difference at  $p < 0.05$  with reference to: 1\* – the senior group, 2\* – the group of 16–18-year-old competitors, 3\* – the group of 13–15-year-old competitors).

Subjects	Statistics	Indices																Σ pts
		1		2		3		4		5		6		7		8		
		s	pts	cm	Pts	s	Pts	kg	Pts	s	Pts	s	Pts	Times	Pts	cm	Pts	
Group of seniors (n=11)	M	7.52	70.7	212	70.5	197.5	61.8	37.6	66.3	32.4	63.8	10.60	67.9	31.3	73.8	15.5	59.5	534.4
	SD	1.11	20.4	12.3	5.0	20.0	5.5	6.4	11.2	16.4	10.2	0.87	7.8	3.2	8.3	7.3	17.0	
	p			2*,3*				2*,3*			2*,3*							
16–18-year-old group (n=15)	M	8.13	59.5	192	61.1	210.9	57.9	32.7	61.8	15.3	55.1	10.88	65.1	30.9	71.0	15.7	59.1	490.6
	SD	0.55	7.8	17.3	8.2	27.8	8.2	6.4	12.6	11.9	9.7	0.51	4.5	4.3	11.3	6.1	10.9	
	p			1*				1*			1*							
13–15-year-old group (n=14)	M	7.99	62.4	199	67.8	199.7	61.8	29.5	60.4	17.2	56.9	10.71	65.4	32.1	70.8	16.7	66.5	513.0
	SD	0.51	7.2	17.1	8.6	21.2	5.9	7.8	15.5	9.8	7.2	0.82	6.3	3.5	7.5	5.1	11.3	
	p			1*				1*			1*							

1 – 50-meter sprint (s), 2 – standing long jump (cm), 3 – 800-meter run, 4 – dynamometer gripping (kg), 5 – flexed arm hanging (s), 6 – 4x10-meter shuttle run (s), 7 – 30-second sit-up (number of times), 8 – trunk bend forward (cm) and the integral index of IPFT general physical fitness, Σ pts IPFT (sum of points).

**Table 3.** Indices of special physical preparation of female judo competitors in three studied groups (statistically significant differences at  $p < 0.05$  with reference to: 1\* – the senior group, 2\* – the group of 16–18-year-old competitors, 3\* – the group of 13–15-year-old competitors).

Subjects	Statistics	Indices						
		1	2	3	4	5	6	7
Group of seniors (n=11)	M	5.3	9.7	9.3	24.3	175	129	12.6
	SD	0.47	0.79	0.79	1.8	7.0	12.9	0.69
	p		2*	2*	2*,3*	3*	2*,3*	2*,3*
16–18-year-old group (n=15)	M	5.8	8.9	8.3	22.1	181	137	14.4
	SD	0.38	0.83	1.03	1.92	10.6	10.8	1.26
	p		1*	1*	1*	3*	1, *3*	1, *3*
13–15 year-old group (n=14)	M	4.7	9.3	8.8	22.9	191	153	15.2
	SD	0.61	0.93	0.80	2.01	4.8	10.2	1.51
	p				1*	1*,2*	1*,2*	1*,2*

1 – the number of throws in series A; 2 – the number of throws in series B; 3 – the number of throws in series C; 4 – sum of throws in three series; 5 – HR immediately after series C [ $\text{bt}\cdot\text{min}^{-1}$ ]; 6 – HR after 1 min rest since series C [ $\text{bt}\cdot\text{min}^{-1}$ ]; 7 –  $I_{\text{SJFT}}$

series. For the last two groups this difference was statistically insignificant ( $p > 0.05$ ).

Seniors and 16–18-year-old athletes had lower mean group indices of the heart beat rates immediately after completion of the test in comparison with 13–15-year-old competitors ( $p < 0.05$ ). The mentioned indices of the heart beat rate did not differ significantly between the first two groups ( $p > 0.05$ ).

After a 1-minute break since completing a series of throws in series C, the mean index of the heart beat rate in the seniors' group was at the level of  $129 \pm 12.9 \text{ bt}\cdot\text{min}^{-1}$ , while in the group of 16–18-year-old juniors and 13–15-year-old competitors the values were high-

er ( $137 \pm 10.8$  and  $153 \pm 10.2 \text{ bt}\cdot\text{min}^{-1}$  respectively). Simultaneously, in the group of 16–18-year-old competitors the mean group index was significantly lower ( $p < 0.05$ ) in comparison to the group of 13–15-year-old competitors. The differences between the three groups of subjects with respect to the index of the SJFT test were analogous. It was the lowest in the seniors' group ( $12.6 \pm 0.69$ ), slightly higher ( $14.4 \pm 1.26$ ) in the group of 16–18-year-olds and even higher ( $15.2 \pm 1.51$ ) in the group of 13–15-year-old subjects ( $p < 0.05$ ).

The next stage in the analysis of results presented in Tables 2 and 3 was to determine the features of correlative relations between the indices of general and special physical preparation in each of the studied groups (Table 4).

**Table 4.** Correlation matrix (r coefficient) reflecting the relations between indices of general and special physical preparation in judo competitors of the three studied groups (bold type denotes correlation coefficients statistically significant at  $p < 0.05$ ).

Studied groups	SJFT indices	IPFT indices							
		50 m run	Standing long jump	800 m run	Dynamometer grip	Flexed arm hanging	4×10 run	Sit-ups (30 s)	Trunk bend forward
Group of seniors (n=11)	Sum of throws in series A	-0.61	0.81	-0.31	-0.50	0.43	-0.44	0.22	-0.08
	Sum of throws in series B	-0.45	0.30	-0.45	-0.38	0.43	-0.58	0.68	-0.09
	Sum of throws in series C	-0.57	0.43	-0.43	-0.26	0.48	-0.52	0.77	-0.38
	Sum of throws in three series	-0.61	0.53	-0.47	-0.41	0.51	-0.60	0.69	-0.23
	HR immediately after series C	0.08	-0.39	-0.09	-0.26	-0.27	-0.09	0.62	0.11
	HR after 1 minute rest after series C	-0.26	0.15	-0.04	-0.14	0.20	-0.11	0.39	-0.24
	ISJFT	0.68	-0.75	0.59	0.33	-0.66	0.71	-0.39	0.17
16–18-year-old group (n=15)	Sum of throws in series A	-0.17	0.47	-0.38	-0.35	0.40	-0.49	0.44	0.09
	Sum of throws in series B	-0.38	0.45	-0.57	-0.13	0.10	-0.57	0.29	0.23
	Sum of throws in series C	-0.12	0.14	-0.33	-0.06	0.25	-0.54	0.36	0.13
	Sum of throws in three series	-0.26	0.36	-0.50	-0.16	0.25	-0.63	0.41	0.19
	HR immediately after series C	0.15	0.33	-0.27	-0.33	0.19	-0.39	0.38	0.30
	HR after 1 minute rest after series C	-0.05	0.14	-0.44	-0.51	0.36	-0.29	0.57	0.30
	ISJFT	0.35	-0.25	0.29	-0.15	-0.09	0.47	-0.11	0.01
13–15-year-old group (n=14)	Sum of throws in series A	-0.28	0.03	-0.20	0.27	0.18	-0.27	0.48	-0.00
	Sum of throws in series B	-0.48	0.19	-0.49	0.09	0.40	-0.41	0.58	-0.03
	Sum of throws in series C	-0.49	0.25	-0.31	0.03	0.35	-0.50	0.52	0.02
	Sum of throws in three series	-0.49	0.19	-0.4	0.13	0.37	-0.45	0.60	-0.00
	HR immediately after series C	0.21	-0.09	0.31	0.36	-0.17	0.27	0.13	-0.03
	HR after 1 minute rest after series C	-0.12	0.50	-0.21	-0.17	0.56	-0.27	0.60	0.17
	ISJFT	0.54	-0.07	0.45	-0.16	-0.25	0.46	-0.44	0.11

According to the results of a correlation analysis, in the group of seniors a greater diversity and power of the relations was revealed in comparison with the other two groups. In four cases in the most advanced group high and statistically significant values of correlation coefficients (from 0.71 to 0.81) were noted. This referred to the following relations:

- standing long jump with  $I_{SJFT}$  ( $r = -0.75$ );
- standing long jump with the number of throws in series A of the SJFT test ( $r = 0.81$ );
- 4×10 m shuttle run with  $I_{SJFT}$  ( $r = 0.71$ );
- sit-ups with the number of throws in series C of the SJFT test ( $r = 0.77$ ).

In six cases correlation coefficients were also statistically significant but at a slightly lower level:

- 50 m run with the number of throws in series A, the sum of throws in the SJFT test, and  $I_{SJFT}$  ( $r = -0.61$ ;  $-0.61$  and  $0.68$  respectively);
- flexed arm hanging with  $I_{SJFT}$  ( $r = -0.66$ );
- sit-ups with the number of throws in series B and the sum of throws in the SJFT test ( $r = 0.68$  and  $0.69$  respectively).

In nine cases the values of correlation coefficients between the indices of IPFT and SJFT tests indicate an average level of relations (they fall within the range of

0.5 to 0.62). However, their significance was not confirmed statistically ( $p > 0.05$ ).

In the group of 16–18-year-old subjects a correlation analysis of the relations between indices of general and special physical preparation did not reveal any close relationships. In five cases their values fell within the range of 0.53 to 0.61 at  $p < 0.05$ . Thus it is an average level of connections and it is statistically significant.

Such a character of relationships refers to the following cases:

- the number of throws in series B with the results of 800 m run and 4×10 m shuttle run ( $r = -0.57$  and  $-0.57$  respectively);
- the number of throws in series C and the sum of throws in the SJFT test with the results of the 4×10 m shuttle run ( $r = -0.54$  and  $-0.63$  respectively);
- HR after 1 min since the completion of the SJFT test with the result of the sit-ups test ( $r = 0.57$ ).

In the group of 13–15-year-old competitors five relationships, whose values fell between 0.54 and 0.60, proved statistically significant. Still all of them indicate an average level of interdependence between indices of the IPFT and SJFT test, namely between:

- sit-ups with the number of throws in series B, the sum of throws in three series and HR after 1 min since completion of the SJFT test ( $r = 0.58$ ,  $0.60$  and  $0.60$  respectively);
- flexed arm hanging with HR after 1 min since completion of the SJFT test ( $r = 0.56$ );
- 50 m run with  $z I_{\text{SJFT}}$  ( $r = 0.54$ ).

## DISCUSSION ON THE RESULTS OF THE STUDY

In consistence with the data obtained in the IPFT test, judo competitors from the senior group are characterised by high indices of general physical preparation, which is reflected in the summary assessment of IPFT – 534.4 pts (according to the IPFT scale of assessment, values 481 pts and more are considered as high indices) [7]. The level of general physical preparation of 16–18-year-old (490.6 pts) and 13–15-year-old (513.0 pts) competitors can be assessed analogously. Yet in all three groups the difference regarding a number of studied indices proved statistically insignificant, which probably was connected to a certain extent with substantial variability of individual indices in athletes from the senior group, especially between the results of 50 and 800 m runs and in the tests of: 4×10m shuttle run, sit-ups and forward trunk bending. The lack of statistically significant differences in the mentioned indices between the three studied groups can also be justified by the fact that regardless

of age differences among judo competitors significant differences in such somatic indices as body height, percentage content of fat and fat-free mass as well as water in the organism were not found.

However, according to mean group indices of strength capabilities (dynamometer grip, flexed arm hanging, standing long jump) senior group competitors clearly exceeded 16–18-year-old and 13–15-year-old athletes, while between the latter two groups this difference proved insignificant.

To assess special preparation of judo athletes from the three studied groups, a special physical fitness test was applied [9], which is widely acknowledged especially in South America.

In the light of hitherto research it was found that the SJFT test meets the conditions of accuracy, precision and it contains the specific effort taking place during a judo fight [9]. The results of the test highly correlate with the results of laboratory tests and the number of attacks during a fight [10].

The ability to perform a large number of throws in a short time mainly depends on the function of anaerobic metabolism, while the value of restitution HR is connected with aerobic metabolism [10]. Hence a higher summary number of throws performed in three series of the SJFT test is connected with a higher effectiveness of senior athletes' anaerobic capabilities. Senior group athletes performed a greater number of throws in three series in comparison with 16–18-year-old and 13–15-year-old competitors, and the difference between the latter two groups regarding the mentioned index was not statistically significant. Senior group athletes obtained the lowest value of the index ( $12.6 \pm 0.69$ ). According to the test author, lower values of the index prove greater achievements in the test. In studies on Polish female competitors [11], the index coefficient amounted to  $13.23 \pm 1.54$  while in the studies on Brazilian athletes preparing to the Paralympics [12] the index value was  $13.09 \pm 1.55$  in the first study and  $12.62 \pm 1.48$  in the second one.

The results of the special physical fitness test (SJFT) regarding the mean group indices of the frequency of heart rate immediately after the test, obtained by Franchini et al. [12], revealed similar values to the ones in the group of seniors and amounted to  $176 \pm 13$  and  $177 \pm 14$ . On the other hand, the values of heart rate indices after 1 min since the completion of the test (in comparison with the group of seniors and 16–18-year-old competitors) were much higher in Brazilian athletes and they amounted to  $159 \pm 7$  and  $156 \pm 5$ . According to Franchini et al. [13], a decrease in the HR at the end of the test with a

given number of throws proves the efficiency of the cardiovascular function, while a decrease in the same index after 1 min since the test proves better regeneration and reflects the improvement in the aerobic function.

In order to characterise the properties of the analysed correlations in the three studied groups of athletes, it should be stressed that in all cases they prove a one-directional character of the relationships between the revealed indices. This means that higher indices of the IPFT test correspond with higher values of the indices in the test of special physical preparation (and vice versa). On the other hand, however, the fact of the increase in the volume and the level of this type of relationships together with the increase in judo athletes' sports mastery becomes fully apparent. Then the issue of an optimal balance in planning the proportions of various aspects of athletes' physical preparation both at specific stages and in their dynamics comes into question. It seems that an appropriate approach would be to apply the principle of selective direction of the training and

the unity of various aspects of the preparation. At the basis of realisation of this principle lies an appropriate use of natural mutual relationships and proportion integrating an athlete's various features, skills and habits in the process of their realisation, development and formation [14].

## CONCLUSIONS

Female judo competitors of the three studied groups are characterised by very high indices of general physical preparation. Seniors exceed 16–18-year-old competitors in the SJFT test in a statistically significant way, and these, in turn, exceed the 13–15-year-old ones.

Highly-qualified judo athletes are characterised by a more expressed and diversified immediate relationship between indices of general and special physical preparation when compared with 16–18- and 13–15-year-old ones. With a progress in judo competitors' sports level, the level of this type of relationships also increases.

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