

## COMPARATIVE ANALYSIS OF THE FORCE, RESISTANCE AND DYNAMIC STRENGTH INDICES VALUES OF 13-15 YEAR-OLD JUDO FIGHTERS IN THE BASIC TRAINING STAGE OF SPORTS TRAINING

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**Abstract:** *According to the objectives of the paper the efficiency of using the means of gymnastics technology were identified by investigating the characteristics of basic motor skills - force, resistance, dynamic strength of 13-15 year old judo fighters in the basic training stage of sports training. The pedagogical experiment found that the level of basic motor skills development was determined by means of motor tests, which, basically, exercises of gymnastics means is situational to the biomechanical structure of the technique of execution of some judo elements, which favours the psychophysical mobilization of the preadolescent judokas to demonstrate performance results. The knowledge of the technology strategies and models of gymnastics mean implementation in the sports training of the 13-15 year old preadolescent fighters in judo has both an explanatory-formative value and an instrumental-operational value for achieving high performances in the activity of the sports training.*

**Keywords:** *sports training, 13-15 year-old judokas, means of gymnastics, motor skills, experimental program, statistical parameters, stretching.*

### 1. Actuality

The basic training of the preadolescent judoka fighter is characterized by a variety of methods, means and organizational forms, with extensive use of elements of various sports training genres. This stage of basic training is given to multilateral training, the volume

of exercises and effort intensity being relatively small [1], [4]. Artistic gymnastics through the complexity of the movements contains means that contribute to the improvement of health, their development from the point of view of the functional, motor, psychomotor and psychological aspects [5, 6, 7, 8]. In this context, it is necessary

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to carry out a global research and to apply new technologies and approaches in the training process in order to improve the system of applying the means.

In the technology of using the means approached by us we present a system of their integration, of the methods and procedures necessary for the correct leading of the training, called to minimize the failures in the sport training process, thus directing them to an anticipated design of the whole educational process, thus the process of using the means in judo fight of 13-15 year-old preadolescents becomes a key issue.

## 2. Methods of Research

The methodology of pedagogical research in this paper becomes a matter of theoretical interest and of great practical importance, because it influences its choice and use appropriate to the concrete situations in the training of judokas aged 13-15 years. The structuring of research methods expresses a certain, relatively special viewpoint, which is attributed to different methodological research categories.

The following research methods were used during the pedagogical experiment: the analysis of the specialized scientific methodical literature, the analysis of the training process documents, the pedagogical observation method, the questionnaire survey method, the somato-functional, motor and

psychomotor tests, psychic properties, the pedagogical experiment, the statistical-mathematical method of data processing, the comparative method, the graphical and tabular method.

## 3. Results

In order to assess the level of development of the absolute strength of some muscle groups, we used the palmar dynamometer, which expresses the force in kilograms, recording the palmar flexor strength (right and left) of the arm, also calculating the muscle strength index (Table 1, tests 1 and 2, Figures 1 and 2).

The arithmetic mean calculated for testing the right arm strength of the experimental group was initially  $24.29 \pm 1.14$  kg and changed to  $29.25 \pm 1.06$  kg at the end of our assessments, pointing to an improvement in the level of development of the absolute strength by 4.96 kg, is 16.96%. The result of this test shows that the significant experimental group progressed compared to the control group. Application of the test  $t$  reveals this development character, the value of  $t$  being calculated as 5,041 compared to 4,437, at a threshold  $<0,001$  for  $f$  equal to 11, which demonstrates the maximum influence of the means on the development of the absolute strength of the left arm. The null hypothesis is rejected, which means a 99.9% probability that the technology of using the means of gymnastics certainly develops the absolute strength of the muscular system of the arms.

Table 1

*Comparative analysis of the values of the muscular strength factors of 13-15 year old judo fighters of the experimental and control groups (n = 24)*

No. ct.	Tested parameters		Group	Statistical Data		t	P
				Initial testing	Final testing		
				$\bar{X} \pm m$	$\bar{X} \pm m$		
1	The absolute strength of the right arm (kg)		E	24,29±1,14	29,25±1,06	5,041	<0,001
			C	22,38±0,41	24,50±0,88	2,97	<0,05
			t	1,58	3,447		
			P	>0,05	<0,01		
2	The absolute strength of the left arm (kg)		E	21,22±0,07	26,25±1,71	4,123	<0,01
			C	20,54±0,50	22,17±0,89	2,289	<0,05
			t	1,346	2,116		
			P	>0,05	<0,05		
3	Muscle strength index (units)		E	51,25±2,35	55,90±1,42	2,479	<0,05
			C	51,22±2,11	50,54±2,68	0,309	>0,05
			t	0,009	1,767		
			P	>0,05	>0,05		
4	Resistance of the dynamic strength of the right arm (kg)	First attempt	E	25,21±1,18	29,25±1,06	4,020	<0,01
			C	21,23±1,72	25,33±0,71	2,906	<0,05
			t	1,908	3,073		
			P	>0,05	<0,01		
		10th attempt	E	23,14±1,18	27,08±0,89	4,119	<0,01
			C	17,69±2,58	20,83±0,71	1,411	>0,05
			t	1,919	5,489		
			P	>0,05	<0,001		
5	Resistance of the dynamic strength of the left arm (kg)	First attempt	E	24,36±1,72	27,95±0,98	2,610	<0,05
			C	22,23±0,28	23,25±1,42	0,803	>0,05
			t	1,222	2,725		
			P	>0,05	<0,05		
		10th attempt	E	21,93±1,57	21,33±0,71	0,471	>0,05
			C	19,54±1,58	17,75±0,97	1,850	>0,05
			t	1,428	2,978		
			P	>0,05	<0,01		

Note: n=24    t=2,074    2,819    3,792  
           f=22    P<0,05    0,01    0,001  
           n=12, f=11    t=2,201    3,106    4,437    r=0,602

Regarding the absolute strength of the control group, the arithmetic mean of the initial test was 22.38 kg, and the final test was 24.50 kg, an increase of 2.12 kg, less compared to the experimental group with 2.84 kg. This absolute strength index demonstrates an improvement in the control group strength (t = 2.89, P <0.05).

The absolute strength of the left arm (Figure 2) of the fighters of the experimental group, the arithmetic mean was initially equal to 21.22 kg and increased to 26.25 kg in the final test, the value of calculated t was 4.123 versus the tabulated t 3,055 at a threshold of 0.01 for f equal to 11, which shows the positive

influence of the technology on the improvement of the left arm's absolute strength. The null hypothesis is rejected, with a probability of 99.0% that the means of gymnastics to develop physical qualities to 13-15 year-old judo fighters. For the control group fighters, the arithmetic mean (Table 1, Figure 2) at the initial test was 20.54 kg, and the final test increased to 24.50 kg, showing an improvement in this motor capacity with a probability of 95.0% ( $t = 2.289$ ,  $P < 0.05$ ).

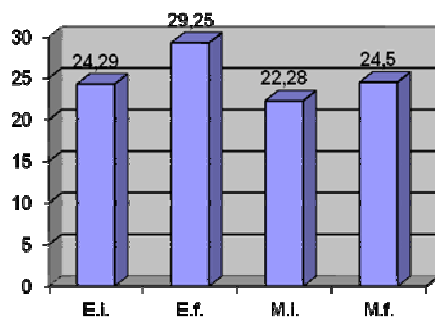


Fig. 1. The graphical representation of the values of the right arm's absolute strength as a factor of the training of the experimental and control group

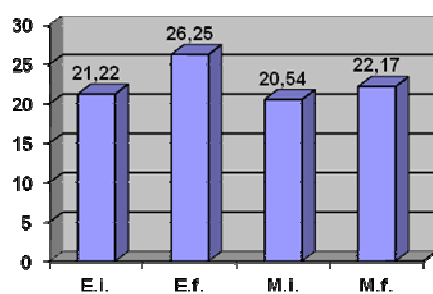


Fig. 2. The graphical representation of the values of the left arm's absolute strength as a factor of the training of the experimental and control group

During practicing exercises on gymnastics apparatus, it was found that in

both experimental groups the absolute arm strength develops significantly with a probability of 99.9%. The value of calculated  $t$  (Table 1) was 3,477, compared to the tabulated  $t$  3.292 at a threshold  $< 0,001$  for  $t$  equal to 24. The absolute strength of the left arm has a significantly lower development, with a probability of 95,0%, the value of the calculated  $t$  being 2,116 compared to the tabulated  $t$  equal to 2,074 at a threshold  $< 0,05$  for  $f$  equal to 24.

In Judo fights, there are procedures executed with the arms, without the use of revelations (Hadaka-Jime), the strangulation begins with leading the right arm with the radial part under the Uke's throat and fixing the kimono grasp at the left shoulder [2, 3, 4], in conclusion, the right upper arm should have a greater strength.

Concerning the muscle strength index, the experimental group fighters (Figure 3) had the arithmetic mean in the initial test equal to 51.25 units, and in the final test 55.90.

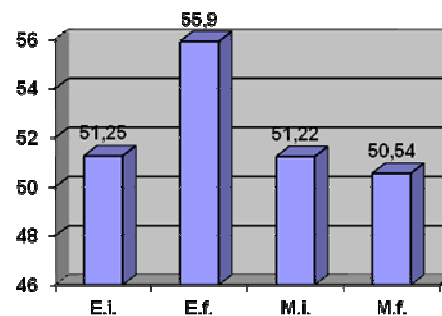


Fig. 3. Graphical distribution of muscle strength index values as a motor factor of the experimental and control group

The test  $t$  highlights a statistically significant difference between the arithmetic averages of the fighters of the experimental group, since the calculated  $t$

was 2,479 compared to the tabulated  $t$  2,201 at a threshold  $<0,05$  for  $f$  equal to 11.

For the index of the muscle strength of the control group fighters, the arithmetic mean (Figure 3.18) in the initial testing was close to the experimental group indicator, equal to 51.22 units, demonstrating the homogeneity of the research groups. In final testing decreased to 50.54 units. The coefficient of variability of 18.40 in the final test compared to the initial test - 14.88, revealed the average homogeneity of the fighters after the application of the traditional training program. Applying test  $t$  revealed a difference that is not statistically significant between the arithmetic averages of the control group fighters, the value of calculated  $t$  being 0.309 compared to the tabulated  $t$  equal to 2.201 at a threshold  $> 005$  for  $f$  equal to 11, which means the control group has not significantly improved the level of physical development, being indicative.

The results obtained by the experimental group in dynamic strength resistance tests were statistically analyzed and presented in Table 1 no. 4 and 5, Figures 4 and 5.

In the case of the dynamic arm resistance test, the calculated arithmetic mean in the experimental group was initially equal to 25.21 kg and increased to 29.25 kg at the end of the evaluations, indicating an improvement in dynamic resistance by 4.04 kg.

The coefficient of variability of 0.17 means that the grouping of data recorded around the arithmetic mean is more pronounced and with great confidence.

Application of the test  $t$  reveals a statistically significant difference between the arithmetic mean of the dynamic strength resistance of the right arm of the judo fighters of the experimental group,

the value of  $t$  being 4,020 compared to 3,106 at a threshold  $<0,01$  for  $f$  equal with 11, demonstrating the positive influence of the applied technology on the development of strength of the right arm muscle, with a probability of 99.0%.

After the 10<sup>th</sup> sample of testing muscular strength resistance of the right arm, it was found that the long-term effort of straining the palmar flexor contractions showed fatigue due to the insufficiency of central nervous system functions. As a result of fatigue, it can be concluded also a significant decrease in muscle strength. The test  $t$  (Table 1) shows a difference of 2.07 kg between the arithmetic mean of the fighters of the experimental group at the initial testing  $25.21 \pm 1.18$  kg and in the dynamometer testing after 10 samples equal to  $23.14 \pm 1.18$  kg. Regarding the dynamic strength resistance of the left arm of the fighters of the experimental group, the arithmetic mean of the dynamic resistance indicators (Figure 4) in final testing was 29.25 kg but in the control group - 25.33 kg. The results of the test  $t$  (Table 1) reveal a statistically significant difference between the arithmetic mean of the fighters of the experimental and control groups, calculated  $t$  being equal to 3,073 compared to the tabulated  $t$  equal to 2,819 at a threshold  $<0,01$  for  $f$  equal by 22. In the sample 10 of the assessment test of muscle strength resistance, arithmetic mean calculated in the experimental group was initially equal to 23.14 kg and increased the muscle strength to 27.08 kg at the end of the evaluations, indicating an improvement of 14.55%. The test  $t$  reveals a statistically significant difference between the arithmetic, initial and final means of the experimental group, with the calculated  $t$

value being 4,119 compared to the tabulated  $t$  equal to 3,106 at a threshold  $<0,01$  for  $t$  equal to 11. In the control group the arithmetic averages are not significant ( $t = 1,411$ ,  $P > 0,05$ ).

The final test results in both groups demonstrate a statistically significant difference, the experimental group obtained a mean result of 27.08 kg, the control group - 20.83 kg, the calculated  $t$  value was 5.488 compared to the tabulated  $t$  equal to 3,292 at a threshold  $<0,001$  for  $f$  equal to 22. The null hypothesis is rejected and the effectiveness of the experimental intervention module on the muscular strength resistance of the right arm after fatigue can be accepted with a probability of over 99,9%. The coefficient of variability in the final test being 0.80 as a proof of a large homogeneity of the experimental group.

Regarding the dynamic strength resistance of the left arm, we make the

following statements of experimental group behaviour. In the case of dynamic resistance, the arithmetic mean (Figure 5) was initially equal to 24.36 kg and increased to 27.95 kg at the end of our evaluation with a difference in arithmetic mean of  $\pm 0.98$ , indicating an improvement in dynamic resistance with 3.59 kg. The coefficient of variability in the initial test was 0.26, constituting a proof of homogeneity of the experimental group. The test  $t$  (Table 1) showed that there is a statistically significant difference between the arithmetic means of the teenager fighters of the experimental group, calculated  $t$  being 2,610 compared to the tabulated  $t$  equal to 2,201 at a threshold  $<0,05$  for  $f$  equal to 11. Thus, we affirm the positive influence of dynamic resistance development exercises on the improvement of motor capacities. The results of the experimental group are not statistically significant ( $t = 0.803$ ,  $P > 0.05$ ).

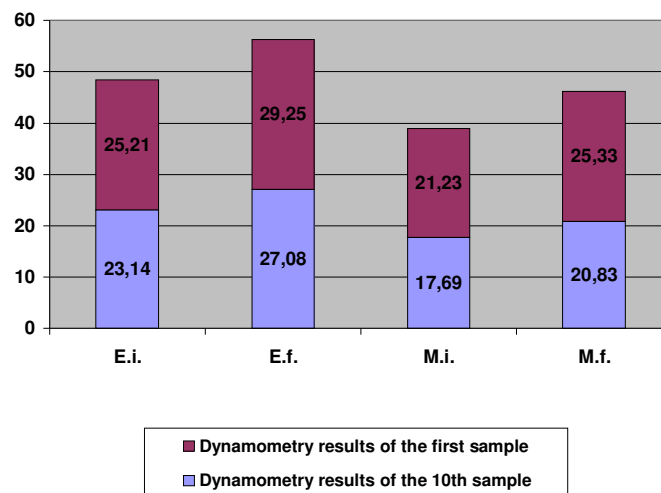


Fig. 4. The graphical representation of the dynamic strength resistance values of the right arm as a factor of the motor training of the experimental and control group

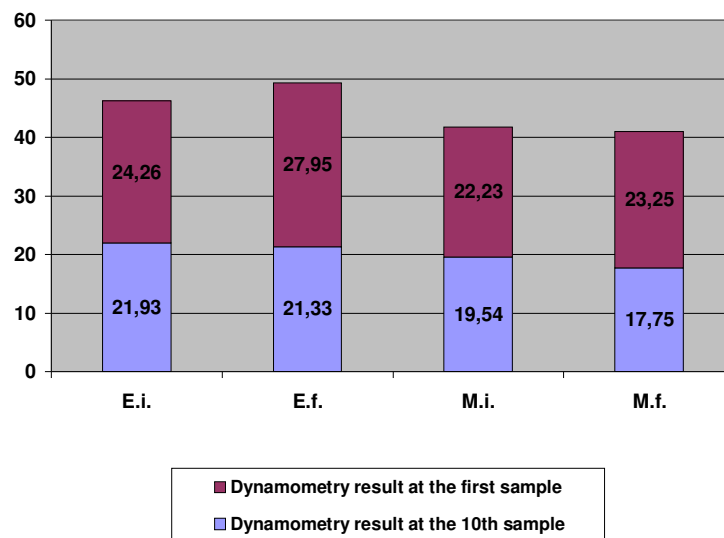


Fig. 5. The graphical representation of the dynamic strength resistance values of the left arm as a factor of the motor training of the experimental and control group

Regarding the dynamic resistance of the 13-15 year-old fighters in the experimental group, the arithmetic mean at the final test was 27.95 kg but in the control group 23.25 kg, the difference demonstrating statistically significant, because calculated  $t$  was 2,725 compared to tabulated  $t$  equal with 2,704 at a threshold  $<0,05$  for  $f = 22$ . This demonstrates the positive influence of the methodology approached in the use of gymnastics on the development of dynamic strength with a probability of 95,0%.

To record the resistance capacity of the left arm's dynamic force, the fighters gripped the dynamometer 10 times with a 5s interval. At the 10<sup>th</sup> time of testing the arithmetic mean (Table 1 and Figure 5) was 21.33 kg compared to the initial sample of 27.95 kg, the resistance decreased by 6.62 kg. In the control group, in the first attempt, the dynamometer vector showed an average

of 23.25 kg, in sample no. 10 was 17.75, muscle strength decreased by 5.5 kg. In the test of 10 attempts of dynamic strength resistance, the arithmetic mean of the final test in the experimental group was 21.33 kg, but in the control group the arithmetic mean was 17.75 kg. Applying the test  $t$  brought a statistically significant difference between the arithmetic mean of the dynamic strength resistance indicators in favour of the experimental group, calculated  $t$  to 2.978 compared to the tabulated  $t$  of 2.819 at a threshold  $<0.01$  for  $f$  equal to 22, which indicates the positive influence of the technology of using the means in the sports training at the basic training stage. The null hypothesis was rejected, which entitles us to assert with a probability of over 99.0% that the experimental investigative module applied in order to improve this motor capacity was effective (Figure 6).

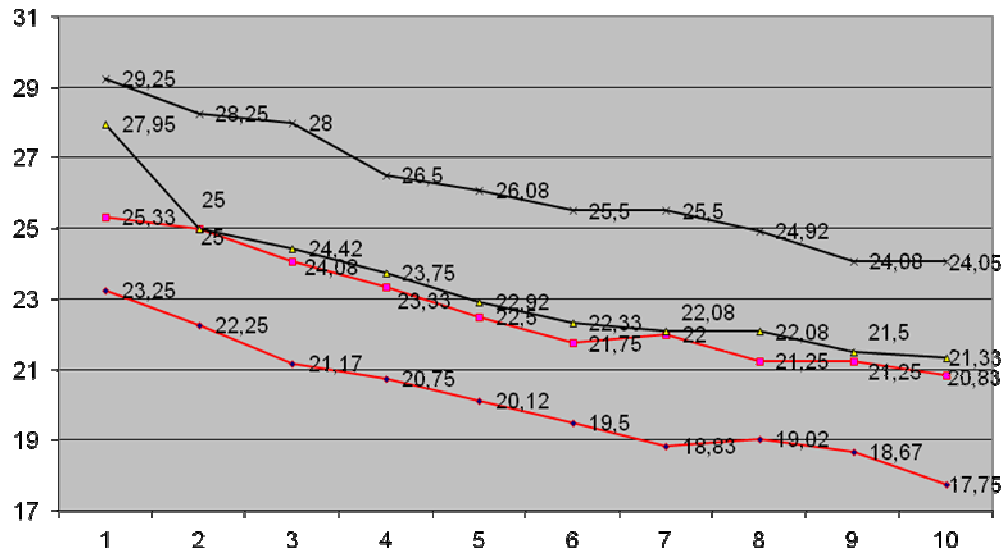


Fig. 6. *The curve of changing the muscular strength resistance of judo fighters aged 13-15 years in the evaluation of the right and left hand flexor dynamometer in the final testing*

Legend: A - Indices of the right hand flexors of the experimental group  
 B - Indices of the left hand flexors of the experimental group  
 C - Indices of the right hand flexors of the control group  
 D - Indices of the left hand flexor of the control group

In such cases it has been experimentally demonstrated that impulses coming from the sympathetic nervous system, as a result of its excitement by muscular strain of the forearm palm in the dynamometer hand grip, lead to the fatigue of the muscular contraction strength. When exercising strength development exercises in resistance mode, adrenaline increases, boosting excitability and results in improved tired muscle functions. According to statistical data, fatigue is more pronounced in the control group on both arms, compared to the statistical data of the experimental group.

At the age of 13-15 years old, the resistance of the dynamic strength is more pronounced at the beginning of the training. In sports training, the

preadolescent fighter makes considerable efforts, the dynamic strength resistance decreases in a very short tempo, fatigue occurs, instead of gaining results, on the contrary, his performance diminishes. In order to increase performance, it is necessary to increase the performance with specific means of judo, in quantitative and qualitative terms, in relation to the different technical components and specific means.

#### 4. Conclusions

1. The knowledge of the technology strategies and models of gymnastics mean implementation in the sports training of the 13-15 year old preadolescent fighters in judo has both an explanatory-formative



value and an instrumental-operational value for achieving high performances in the activity of the sports training.

2. Joint mobility research indicates that fighters in the experimental group achieved a statistically significant mean in the final test against the control group, with a greater probability of 95-99.9% with the value of *t* calculated from 2.458 to 5.980,  $P < 0.05$  to 0.001.

3. The level of development of the basic motor skills was determined by means of motor tests, which basically, the exercises of the gymnastics means situationally represent the biomechanical structure of the technique of execution some judo elements, which favours the psychophysical mobilization of the preadolescent judokas to show performing results. The calculated *t* value varies from 3,849 to 5,819 at a statistical threshold  $< 0.01-0.001$ .

4. The statistically significant results of the scientific research show that the improvement of the motor and psychomotor capacity indicators, achieved by the fighters of the 13-15 year-old experimental group, represent the effects of the isolated and integrative actions of the exercise module of artistic gymnastics means, recording a value of calculated *t* of 3,849-5,819 compared to the tabulated *t* equal with 3,106-4,819 at a threshold  $< 0,01-0,001$  with a probability of 99,5-99,9%, experimentally confirming the technology of intervention of the means elaborated by us for 13 -15 year-old Judo fighters.

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