

## RESEARCH ON THE EFFECTS OF RESISTANCE TRAINING ON THE SPECIAL STRENGTH OF JUDOISTS

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The physical fitness of athletes holds a significant place in achieving results in competitions in all areas of sport. Apart from the inexhaustible multitude of technical elements that judo possesses, the improvement of physical and functional abilities is a good basis for achieving top results.

It is usual that the condition training of judoists is planned to incorporate three main phases, each of which is characterized by its own special dynamic:

- phase one consists of the work involved in a training program which is aimed at the development of the so-called basic foundations (strength and endurance), which take up a great part of general many-sided training,
- phase two requires a smaller amount of overall work, but a greater intensity of effort, in order to develop the so-called specific competitive foundations of judoists,
- phase three of condition training builds up specific abilities, the competitors' agility as well as motoric and situational motoric skills.

This research has as its aim to show the basic principles of the training process in the preliminary period, the application of the model for the training of the specific strength of judoists and the changes which take place due to the application of this training model, all during the period of time covered by this research. The research included judoists who participate in competitions at the national level. Six tests were used to check the special strength of judoists. The results of the research indicate that during the experimental treatment (the preliminary period), a statistically relevant increase in the special strength of judoists was detected by means of all the tests used for measuring it.

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*Keywords: Strength exercise, special strength, programme, judo.*

### INTRODUCTION

In this past decade, a rather swift and intense development in judo was observable. More and more, one could note the appearance of new throwing techniques or their variants with different moves which have been developed by the national teams of the former Soviet Union and of some of the western countries. The introduction of new rules and the change in weight categories, along with the decrease in the duration of the matches, increases the attraction, efficiency and the dynamics of the match. Since that during a match there are constant changes in the dynamic situation, the competitor is required to adapt the technically-tactical stereotypes which he uses, the ability to reorganize these stereotypes at a moment's notice and a continuous creation of new advance, defense and counter-attack programs of action. The fact that the judo match is carried out by means of a direct confrontation of the participants, not to mention the fact that the fight lasts for five minutes, tells us of a great consumption of energy on the part of the contestants in the competition.

It is precisely because of this great consumption of energy that functional abilities have priority in judo. Due to continuous pressure, where we have instances of a shift between the aerobic and anaerobic mechanisms of the body, the judoist subjects himself to a specific training process for the purpose of increasing his functional abilities. The functional abilities of judoists, and especially the aerobic ones, are quite emphasized because of the great energy consumption during a single match, which lasts continuously for five minutes. Judo competitions are mainly held in the form of tournaments and the contestants participate in a greater number of fights during one day (Ćirković, 1991).

Apart from the inexhaustible multitude of technical elements that are found in judo, the improvement of physical and functional abilities is a good basis for achieving top results.

The main goal of any judoist is to gain a good advantage over his/her adversaries during competitions. In order to achieve that, he must first achieve his/her set short-term goals for the ongoing season. The yearly cycle of condition training consists of various tasks performed

over certain periods; it requires a specific, directed development of strength, speed, and endurance and must match the phases and cycles of training.

It is common to plan the condition training of judoists so that it contains three main phases, where each of them is characterized by special dynamics:

- phase one consists of work as part of the training aimed at developing the so-called "basic foundations" (strength and endurance), and which requires a great part of the training sessions;
- phase two requires a lesser overall work load, but a greater intensity, in order to enable the development of the so-called specific competitive foundations of judoists;
- phase three of the condition training builds up specific abilities, competitors' agility and motoric and situational motoric skills.

The programming of a year-long training schedule for judoists depends on how many important competitions will be held during the course of that one year (Ćirković, 1991).

The initial part of each yearly plan will vary based on the individual needs of each contestant, and the circumstances under which it will be carried out.

## THE AIM OF THE RESEARCH

In practice, what is meant by the periodization of sports training is the shaping of macro cycles which make up separate time and structure wholes, comprised of MEZO and micro cycles. A single macro cycle, lasting for one or more years, is divided into three periods: the preliminary period, the period of competition and the transition period. They last or replace each other depending on the competition calendar and the quality of the competitors. The division is made in order to facilitate the management of the state that the judoist is in due to his/her training, and the easier control of all the elements which will determine the form of the judoist. Depending on the duration of the season, a periodization consisting of one or two periods could take place, or to be more precise, a periodization consisting of one or two cycles. In the case of high quality competitors, a periodization consisting of two cycles is more characteristic.

The goal of every preliminary period is to satisfy all the requirements that could lead to the achievement of top results during the season, or to the achievement of top form. During this period, many of the basic tasks involved in the development of a high level of functional abilities are carried out, and they in turn ensure a successful completion of the great work load that needs to be carried out during any specific preparations, and the preparations for competition. The preliminary pe-

riod has three phases made up of the basic, specific and situational preparations, and special attention is paid to the development of all kinds of strength, coordination, functional abilities, and the correction of mistakes in technique and in tactics, the learning of the technically-tactical elements of this theoretical and psychological preparation. The relationship between the basic, specific and situational preparations differs and depends on the quality of the competitor.

This research has as its aim to demonstrate the basic principles of the training process during the preliminary period, the application of the training model for the specific strength of judoists and the changes which take place during the course of the application of this training model during the course of the research.

## THE RESEARCH HYPOTHESES

**H1** What is expected is that the applied training models for the judoists during the preliminary period will influence the changes made to the special strength of the judoists in a statistically relevant manner.

## METHODOLOGY

### The sample of examinees

The sample numbered 16 selected judoists, where the basic criteria for making the selection was: that all the examinees were aged between 17 and 20; that they were all members of judo clubs; that they were all participants in competitions for a period no less than 6 and no more than 11 years; that they were all participants in official competitions in the country, while four of them were junior and two of them senior representatives of Serbia and Montenegro; that they all had 8 to 10 training sessions a week during the preliminary period; that the training sessions lasted from 90 to 120 minutes; that they all had a clean bill of health.

### The output of variables

An analysis of the form they were in as a result of their training is as necessary and irreplaceable as the training plan and program can only be put together if there is enough relevant data on the morphological, motoric, functional and biomechanical status of the contestants. Only the qualities and skills that have a significant impact in the equation for success specification in judo are tested.

The sample of variables for this research included six motoric variables which measured the strength of individual muscle regions, that is:

- bench press (MSNBE)
- dead lift (MSNBE)
- shoulders (back press) (MSNNA)

- barbell squat (MSNDC)
- pull-ups (MSNZV)
- crunches (MSNPT)

All variables were measured at the beginning and at the end of the preliminary period.

#### The plan and program for the preliminary period

By analyzing the structural-biomechanical characteristics of judoists, we can see that the structure of the specification equation is not simple and that it contains a great number of anthropological characteristics. Some of them are quite necessary, some less and some more relevant when it comes to achieving top results.

The size of the coefficients for participation of particular characteristics is relative and they can only be discussed hypothetically. On the basis of long-term experience and some findings originating from the research that was carried out up till this point, it seems that the different forms of strength manifestation (explosive, repetitive, static) and of coordination are the most important elements which participate in determining the success in a judo match (Matveev, 1985).

The plan and program used for preparing judoists during the preliminary period had as its aim the improvement of basic skills, special motoric skills, and functional skills.

The special strength training was carried out five times a week and in such a manner that during one training session, as its main segment, exercises involving two to three great muscle regions were performed: bench press, dead lift, rowing, barbell squats, shoulders, pull-ups, crunches along with some support exercises, which were aimed at a smaller group of muscles. The training plan was made up of two phases, both of which lasted for three weeks. During each week, ten training sessions were held, lasting from 60 up to 90 minutes. The main goal of the first phase was the increase of the basic skills of aerobic endurance-training inside a gym or out in the open, and of strength-training in the gym. The second work phase consisted of five training sessions which were aimed at the development of endurance, and another five for the development of the special strength of judoists.

On the basis of the measured results at the initial measuring, a program was put together for each individual contestant. After the completion of the test, an initial status was obtained on the basis of which each examinee was allotted his/her own training programme for the week. Each completed week during the first and

TABLE 1

A weekly exercise schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Gym training	Gym training	Gym training	Break	Gym training	Gym testing for as long as the competitor can endure	Break
Judo techniques or outdoor running	Judo techniques or outdoor running	Judo technique or outdoor running	Break	Judo technique or outdoor running	Judo technique or outdoor running	Break

TABLE 2

Phase one, three weeks

Day of training	Training exercises	t % of max	The number of repetitions	The number of sets
Monday Wednesday	1. main exercise: <b>bench press</b> Support exercises: bench press to the side, extensions, barbell upright rows, pull-downs.	55%	6-8 4-6 4	1
	2. main exercise: <b>dead lift</b> Support exercise: grip leverage row	65% 75%	4	1
	3. main exercise: <b>rowing</b> Support exercise: altering from one side of the hip to another	85% 65%	(as many times as the competitor can endure)	6 1
Tuesday Friday	1. main exercise: <b>dead lift</b> Support exercise: grip leverage row	55%	6-8 4-6	1
	2. main exercise: <b>squat</b> Support exercises: "front" squat, standing on one's toes (calves)	65% 75%	4 4	1 1
	3. main exercise: <b>shoulders</b> Support exercises: 3/4 dead lift, standing barbell curls, winding the barbell.	85% 65%	(as many times as the competitor can endure)	6 1
Saturday	A testing for all the main exercises	100%		

second phase, actually represented a micro cycle of its own.

During this period, apart from the already mentioned main exercises, the program also included additional support exercises: *bench press to the side, extensions, grip leverage row, altering the barbell from one side of the hip to another, barbell upright row, 3/4 dead lifts, pull-downs (triceps), winding the barbell, standing barbell curls, the "front" squat, standing on one's toes (calves).*

The support exercises were performed at 80% of maximum strength, and during the first phase within sets of four, and during the second session within sets of five, where the number of repetitions was no greater than ten and no smaller than six. The crunches exercise and the pull-ups were performed 25 to 35 to a set, or rather, every time until the competitor was worn out.

### The training scheme

The main exercises that were included in the training programme:

1. - bench press,
2. - dead lifts,
3. - rowing,
4. - barbell squats,
5. - seated dumbbell press,
6. - pull-ups,
7. - crunches.

Fig. 1



Fig. 2



Fig. 3



Fig. 4

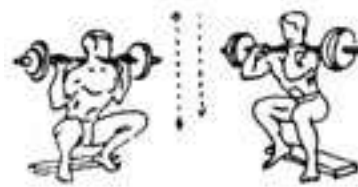


Fig. 5



Fig. 6



Fig. 7

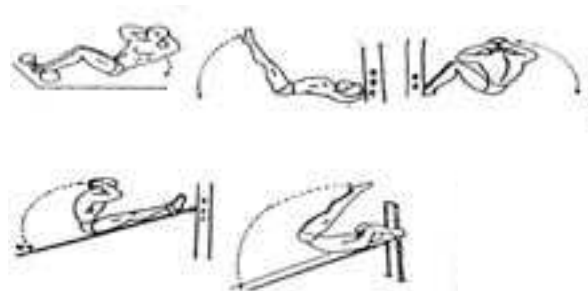


TABLE 3

Phase two, three weeks

Day of training	Training exercises	t % of max	The number of repetitions	The number of sets
Monday Wednesday	1. main exercise: <b>bench press</b> Support exercises: bench press to the side, extensions, barbell upright rows, pull-downs	55%	6-8	1
	2. main exercise: <b>dead lift</b> Support exercise: grip leverage row	65%	4-6	1
	3. main exercise: <b>rowing</b> Support exercise: alternating from one side of the hip to another	75%	4	1
Tuesday Friday	1. main exercise: <b>dead lift</b> Support exercise: grip leverage row	90%	(as many times as the competitor can endure)	6
	2. main exercise: <b>squat</b> Support exercises: "front" squat, standing on one's toes (calves)	65%		1
	3. main exercise: <b>shoulders</b> Support exercises: 3/4 dead lift, standing barbell curls, winding the barbell	75%		1
		90%		6
Saturday	A testing for all the main exercises	65%		1
		100%		

### The methods of data analysis

Due to the outline of the experiment it was necessary to gather the information at both the initial and final measuring. For analyzing the changes that occur in the resulting values of the variables between the initial and final measuring, a t-test for the dependent samples was used, and the relevance of the conclusions was determined at the  $p < 0.05$  level.

The following parameters were calculated:

M – means, SD – standard deviation, MIN – minimal results, MAX – maximum results, R – the result span, SKW – skewedness, KURT – kurtosis, r – the connection between the results of the two measuring, p – the relevance of that connection, T – the value of the t-test, and P – the margin of error while rejecting the hypotheses that the difference is not significant.

## THE RESULTS OF THE RESEARCH AND THE DISCUSSION

**TABLE 4**

The basic statistical parameters of the measured variables at the initial measuring

Variables	SV	MIN	MAX	RASP	SD	SKW	KURT
MSNBE	82.18	65.00	110.00	45.00	14.60	.69	-.61
MSNRM	48.12	35.00	60.00	25.00	6.80	-.11	-.55
MSNNA	66.56	45.00	85.00	40.00	10.28	-.11	.21
MSNDC	92.81	75.00	120.00	45.00	15.27	.45	-1.44
MSNZV	14.31	7.00	22.00	15.00	4.70	.18	-1.02
MSNPT	113.81	60.00	200.00	140.00	39.90	1.06	.58

The analysis of the results of the initial measuring indicates that the registered variables for the Bench press (MSNBE) ranged from 65 kg to 110 kg. The mean was 82.18 kg with a standard deviation of 14.60 kg. Distribution-wise the results were spread out and the results are grouped more heavily around the lower values.

In the case of the shoulders (MSNRM) variable, the registered results ranged from 35 kg to 60 kg. The mean of the results was 48.12 kg with a standard deviation of 6.80 kg. Distribution-wise the results were spread out.

Analyzing the Dead lifts (MSNNA) variable, we can note that the registered results range between 45 kg and 85 kg. The means is 66.56 kg with a standard deviation of 10.28 kg. Distribution-wise the results are well placed.

In the case of the barbell squats (MSNDC) variable, the registered results range from 75 kg to 120 kg. The means of the results is 92.81 kg with a standard deviation of 15.27 kg. Most of the results are grouped around the lower values, and the range of the results has conditioned the results' being rather spread out on the graph.

Analyzing the pull-ups (MSNZV) variable, we can note that the registered values range from 7 to 22 pull-

ups. The mean of the results is 14.31 pull-ups with a standard deviation of 4.70 pull-ups. The results are spread out equally distribution-wise.

In the case of the crunches (MSNPT) variable, the registered results range from 60 to 200 repetitions. The mean of the results is 113.81 repetitions with a standard deviation of 39.90 repetitions. The results are grouped around the lower values but due to the wide range of the results, the graph is extended, or rather, a smaller number of examinees had results with higher values.

**TABLE 5**

The basic statistical parameters of the measured variables at the final measuring

Variables	M	MIN	MAX	R	SD	SKW	KURT
MSNBEF	86.25	65.00	110.00	45.00	13.72	.47	-.62
MSNRMF	53.43	45.00	60.00	15.00	4.36	.02	-.55
MSNNAF	72.50	55.00	90.00	35.00	10.80	.29	-.86
MSNDCF	100.31	80.00	140.00	60.00	19.44	.73	-.64
MSNZVF	17.43	8.00	25.00	17.00	5.03	.11	-.56
MANPTF	123.37	71.0	208.00	137.00	39.38	1.11	.52

By analyzing the results at the final measuring we can clearly note that there has been a numerical increase in the values of all the measured variables. By analyzing the individual results we come to the following conclusions:

- The registered values of the results of the bench press test range from 65 kg to 110 kg. The means was 86.25 kg with a standard deviation of 13.72 kg. The distribution of the results showed that the results were well grouped around the means, but that a smaller number of examinees had significantly higher result values, which led to a greater result range.
- In the shoulders test, the registered values of the results ranged from 45 kg to 60 kg. The means was 53.43 kg with a standard deviation of 4.36 kg. Distribution-wise the results are spread out and they are evenly grouped around the means.
- The registered values of the dead lift test range from 55 kg to 70 kg. The means was 72.50 kg with a standard deviation of 10.80 kg. Distribution-wise the results are spread out and only a small number of examinees had low result values.
- In the case of the barbell squats variable, the registered values range from 80 kg to 140 kg. The range of the results is rather wide. The means was 100.31 kg with a standard deviation of 19.44 kg. Distribution-wise the results were spread out and more heavily grouped around the lower values.
- The registered values for the pull-ups variable range from 8 pull-ups to 25 pull-ups. The means was 17.43 pull-ups with a standard deviation of 5.03 pull-ups. The results are well grouped around the means and a small number of examinees had significantly larger result values compared to the means.

- In the case of the crunches variable, the registered results range from 71 repetitions to 208 repetitions. The mean was 123.37 repetitions with a standard deviation of 39.38 repetitions. The range of the results was very wide as a small number of examinees had extremely high result values. The rest of the results were well grouped around the means.

What is interesting is that in the case of all the measured variables at the initial and final measuring, a wide range of results was detected. The reason should be looked for in the different weight categories of the contestants, which ranged from 60 kg to 81 kg.

The quantitative aspect of the changes is determined by the testing of any significant differences between the results that were obtained at the initial measuring and at the final measuring. An analysis of the significance of the differences was done at the univariate level by means of the T-test.

In the following table we can find the means (SV), the standard deviation (SD), the connection between the results of the two measurements ( $R_{12}$ ), the significance of that connection (Pr), the value of the T-test (T) and the margin of error for rejecting the hypothesis in view of the fact that the difference is not relevant (P).

The obtained results indicate that during the research period, statistically relevant improvements occurred in the measured results. The obtained values for the correlation between the first and second measurements are very high and range from 84 to 99. This fact indicates that during the research period, even and steady changes took place in all the examinees.

The values of the results, in all the tests of strength, were significantly increased during the preliminary period. The growth tendency of the results is such that we cannot determine whether the examinees made good use of the preliminary period and in that way made it possible for themselves to enhance their abilities and scopes.

**TABLE 6**

The differences between the initial and final measuring

Variables	M	SD	r	p	T	P
MSNBE	82.18	14.60				
MSNBEF	86.25	13.72	.97	.00	-4.96	.00
MANRM	48.12	6.80				
MSNRMF	53.43	4.36	.84	.00	-5.50	.00
MSNNA	66.56	10.28				
MSNNAF	72.50	10.80	.93	.00	-6.33	.00
MSNDC	92.81	15.27				
MSNDCF	100.31	19.44	.96	.00	-4.95	.00
MSNZV	14.31	4.70				
MSNZVF	17.43	5.03	.97	.00	-11.49	.00
MSNPT	113.81	39.90				
MSNPTF	123.37	39.38	.99	.00	-8.52	.00

## CONCLUSION

Apart from the inexhaustible multitude of technical elements to be found in judo, the improvement in physical and functional abilities represents a good basis for achieving top results.

It is considered that what is of the greatest significant for a sports match are the various forms which are among the manifestations of strength (explosive, repetitive, static), coordination, speed, balance and flexibility. It should also not be forgotten that a top judoist is characterized by highly developed functional skills of the aerobic and anaerobic type.

Following the general principles for applying the method for the development of special strength of judoists, individual plans for each of the judoists were made.

It has been experimentally proven that a six-week training model designed for the special strength of judoists has an effect on the statistically relevant increase in the special strength of judoists. In this way, the proposed hypothesis has been validated.

We can conclude that without the development of optimal conditioning or physical fitness, it is not possible to achieve any number of results either on the national or international level.

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**VÝZKUM ÚČINKU SILOVÉHO TRÉNINKU  
NA SPECIÁLNÍ SÍLU JUDISTŮ**  
(Souhrn anglického textu)

Tělesná kondice sportovců zaujímá významné místo v dosahování výsledků při závodech ve všech sportovních oblastech. Bez ohledu na nevyčerpatelné množství technických prvků, které judo obsahuje, zdokonalení fyzických a funkčních schopností je dobrý základ pro dosažení nejvyšších výsledků. Je obvyklé, že kondiční trénink judistů je plánován tak, aby zahrnoval tři hlavní fáze, přičemž každá z nich je charakterizována svou vlastní speciální dynamikou:

- fáze 1: skládá se z práce zahrnuté v tréninkovém programu, jehož cílem je rozvoj tzv. hlavních základů (síla a vytrvalost), což zabere velkou část celkového všestranného tréninku;
- fáze 2: vyžaduje menší množství celkové práce, ale větší intenzitu námahy, aby se rozvinuly tzv. specifické soutěživé základy judistů;
- fáze 3: kondiční příprava vytváří specifické schopnosti, hbitost, motorické a situačně-motorické dovednosti závodníka.

Cílem tohoto výzkumu je ukázat základní principy tréninkového procesu v přípravném období, aplikaci tohoto modelu v tréninku zaměřeném na specifickou sílu judistů a změny, které nastávají díky aplikaci tohoto tréninkového modelu; během celého období probíhal výzkum. Tento výzkum zahrnoval judisty, kteří se účastnili soutěží na národní úrovni. K ověření speciální síly judistů bylo použito šest testů. Výsledky výzkumu ukazují, že během experimentálního zpracování (přípravné období) bylo určeno statisticky významné zvýšení speciální síly judistů, a to prostřednictvím všech testů, kterých bylo pro měření použito.

*Klíčová slova: silová cvičení, speciální síla, program, judo.*

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