

Original research article

THE MOTOR POTENTIAL OF YOUNG JUDOKAS IN SLOVENIA

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Abstract. *The research was carried out with an aim of determining the level of motor potential among cadet and junior prospective national team members of Slovenia (extended list), aged 13 to 16, as well as to determine the differences among 3 groups of judokas (weight categories: up to 60 kg, up to 73 kg and exceeding 73 kg). The sample of participants for this study consisted of 181 judokas, potential candidates for the junior and cadet national team of Slovenia. To evaluate motor potential, the handgrip strength, abdominal strength and endurance, agility, aerobic capacity and explosive leg strength were evaluated. The testing of motor potential was carried out using the mobile laboratory of Sports Consulting Chamber from Slovenia and Slovenian Judo Federation. Based on the obtained results it was concluded that there are statistically significant differences between the indicators of motor potential among the three studied categories of judokas. What should especially be noted was that judokas in the weight category of up to 60 kg were weaker in hand strength and agility than judokas weighing up to 73kg and judokas exceeding 73 kg.*

Key words: *motor skills, competitive categories, judokas.*

INTRODUCTION

Judo as a sport belongs to the group of polystructural and acyclical movement sports with very complex elements which are performed in various phases of the match. The success of both the performance of the set tasks, and the match itself are influenced by numerous factors and dimensions. If we were to specify the motor space in judo for younger categories, the first three highest ranked abilities would include strength, speed and coordination (Sertić, 1997). Considering the fact that a certain situation in a match is never repeated twice in the same manner, judokas are forced to react in a very short

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period of time irrespective of whether they are in an attack phase or defense phase. In judo training in general, great attention is given to the development and training of motor skills (strength, speed, coordination, balance, endurance, flexibility).

Some studies have shown that judokas possess exceptional strength, capacity and flexibility, as well as a low level of body fat (Thomas, Cox, LeGal, Verde & Smith, 1989). With the development of modern judo, and considering the various somatic types of people, there was a need for the types to be divided into more homogenous groups, based on body mass. Accordingly, certain rules of combat were made. During official competitions, judokas compete against opponents with similar body mass, in accordance with their weight categories. The aim of the division into categories is to provide a fair and equal match in the sense of strength, power and agility (Artioli et al., 2010).

Numerous studies exist which focus on the motor skills and other anthropological features of judokas with the help of standard instruments, as well as studies focused on determining the relations between sports-technical results of fighters and the extent of development of these features (Imamura, Hreljac, Escamilla, & Edwards, 2006; Perrin, Deviterna, Hugel, & Perrot, 2002; Bratić, Radovanović, & Nurkić, 2008; Atanasov, Bratić, Nurkić, Đurašković, 2005; Kafenterakis & Bratić, 2006; Drid, Drapšin, Trivić, Bratić, & Obadov; Stanković, Nurkić, Todorov, Milošević, & Bratić, 2012). Popović (1980) studied the motor skills of 237 judokas, pioneers, aged between 11 and 12. Their motor skills were determined using 20 tests. Using an analysis of factor structure, three factors were obtained: the first factor is responsible for the structuring of movement; the second factor is responsible for the regulation of excitation intensity and the third factor is responsible for the duration of excitation. Bratić (1993) studied the relations between basic motor skills and complex motor tasks (judo techniques), on a sample of 234 participants, aged 18 to 25. For the evaluation of motor skills (explosive strength, speed, coordination, balance and agility), 14 tests were used. For the evaluation of complex motor tasks 8 judo techniques (tests) were used. Based on the appropriate statistical data processing significant results were obtained in explosive strength, coordination and balance.

Bratić & Đurašković (2000) studied somatometric characteristics and functional abilities as the factor of success in the competitions of young judokas. The study was carried out on a sample of 50 selected judokas belonging to weight categories of 60 kg, 66 kg, and 73 kg. To evaluate their morphological characteristics, 21 variables were used, while to evaluate their functional abilities 3 variables were used. The results of the research have shown that the champions of Yugoslavia had lower values of body height and shoulder width and greater values of thorax volume, upper arm, and lower arm volume, and hand length. Smaller values of skinfolds were determined in comparison to competitors of their own weight categories. In addition, aerobic and anaerobic abilities of the champions of Yugoslavia were significantly better.

The aim of this research was to determine the differences in the motor potential between judokas, who actively take part in judo, in relation to the three weight categories. It is assumed that the level of motor potential of the three groups of selected judokas will differ in a statistically significant manner.

THE METHOD

The sample of participants

The research was carried out on a sample of 181 young judokas that are part of the extended list of members of the cadet and junior national team of Slovenia, aged 13 to 16. The participants had fulfilled the following conditions: they were on the list of prospective national team members of Slovenia; had no organic or somatic illnesses; were aged between 13 and 16 years; had trained in a club at least 4 times a week; trained for at least 4 years. All of the participants were divided into three sub-samples in relation to their mass: a) weighing less than 60 kg (63 participants), b) less than 73 kg (60 participants) and c) exceeding 73 kg (58 participants).

The sample of variables

To evaluate motor potential hand strength, abdominal muscular strength and endurance, agility, endurance and explosive leg strength were tested.

The testing of motor potential was carried out with the help of the mobile laboratory Sports Consulting from Slovenia and Slovenian Judo Federation.

The measuring instruments

The handgrip strength test in kilograms (kg): The subject holds the dynamometer in the hand to be tested, with the arm flexed to 90 degrees in the shoulder joint, and the arm hanging down by the side of the body, respectively. The variables: DR1 - the right hand handgrip strength with the arm flexed (kg), LR1 - the left hand handgrip strength with the arm flexed (kg), DR2- the right hand handgrip strength with the arm hanging down (kg), LR2- the left hand handgrip strength with the arm hanging down (kg).

Abdominal muscular strength and endurance test was performed in the prone lying resistance position with the trunk raised and kept on the forearm. The aim is for the participant to hold the position for as long as possible. Time was measured using a stopwatch in seconds. Variable: ASE-abdominal strength and endurance (s).

The T-Test of agility that includes forward, lateral, and backward running was carried out in a space of the dimensions 6x6 meters. The judoka performs the test 4 times: twice with a change in direction to the left and twice with a change in direction to the right. The duration in seconds was determined using a system of photocells (Witty Microgate, Italy). Variables: T_TEST_RIGHT - overall duration of the test (s), T_TEST_LEFT - overall duration of the test (s).

In order to assess the ability to recover and repeat intermittent activity the Beep test »30-15« is performed on a tatami surface 20m long. The participants run barefoot. The audio signal is emitted from a recorded sound source. The participants run a distance of 20m in the following manner: 30 seconds of running, followed by a 15-second walk. The first running speed was 8 km/h. Each 45 seconds the speed increased by 0,5 km/h. The running tempo gives the beep audio signal at each point. The aim of the participant is to run the greatest possible distance. If the participant lags behind 3 m before a line twice, the test ends. The greatest running speed (VMAX) was measured [km/h]. Based on the data on body mass and age, maximum oxygen uptake was calculated (VO2MAX) inml/kg/min.

Explosive strength was estimated through the counter movement jumps (CMJ). The jump heights were measured on a bilateral tensiometric platform (S2P, Slovenia); 2 platforms–300x600mm, 1kHz–synchronized. Ground reaction force was an indication of regularity of the jump technique. Variable – CMJ (cm).

Methods of data processing

For the purposes of this study the basic descriptive parameters for all the applied variables were calculated. The difference between the subsamples was determined using the ANOVA and MANOVA (Bonferroni) statistical analysis methods. The results were processed using the SPSS 14.0 program. In order to determine significance of the differences, the 5% error of margin was accepted (alfa)

RESULTS

The basic central and dispersion parameters

For the purpose of this research, the average age of the participants was calculated, average body mass and average body height (Mean±St.Dev.). The average age of the judokas weighing up to 60 kg was 14,18 ± 4,6 years, the average body mass was 53,91 ± 4,58 kg and the average body height 164,20 ± 6,30 cm; the average age of the judoka weighing up to 73 kg was 14,56 ± .95 years, average body mass was 65,20 ± 3,67 kg and average body height was 171,86 ± 4,86 cm; the average age of a judoka weighing over 73 kg was 14,63 ± .94 years, average body mass was 84,51 ± 9,60 kg and average body height was 180,46 ± 8,95 cm.

Table 1 Basic statistical parameters of judokas weighing up to 60 kg, up to 73 kg and in excess of 73kg

Parameter	Judokas weighing														
	Up to 60 kg					Up to 73 kg					In excess of 73 kg				
	N	Min	Max	Mean	Std. Dev.	N	Min	Max	Mean	Std. Dev.	N	Min	Max	Mean	Std. Dev.
ASE (s)	63	130	300	246,97	58,15	60	58	300	218,2	81,49	58	47	300	150,74	79,71
CMJ (cm)	63	20,3	42,3	32,55	5,15	60	21,6	47,1	33,22	5,67	58	18,7	46,7	32,44	14,73
T_TEST_	63	6,01	8,12	7	0,55	60	5,93	8,1	6,93	0,53	58	6,04	8,91	7,27	0,76
LEFT (s)															
T_TEST_	63	5,98	8,03	7,04	0,52	60	5,95	8,21	7	0,56	58	5,86	9,12	7,41	0,82
RIGHT (s)															
LR1 (kg)	63	26	54	37,8	7,28	60	30	56	43,87	6,46	58	36	78	51,72	10,93
LR2 (kg)	63	25	55	37,13	7,43	60	26	55	43,39	6,93	58	30	70	50,5	11,03
DR1 (kg)	63	25	52	38,04	7,39	60	30	56	46,47	6,62	58	34	81	54,56	11,49
DR2 (kg)	63	27	54	38,21	7,95	60	31	64	45,99	7,22	58	36	70	52,03	9,41
Vmax (km/h)	63	14,5	19	16,34	1,2	60	13,5	19,5	16,71	1,56	58	12,5	19	15,5	1,69
VO2max (ml/kg/min)	63	38,63	49,18	43,72	2,62	60	36,11	49,88	44	3,04	58	33,64	49,03	41,62	3,41
categories	1					2					3				

Based on the values from table 1, it could be noted that average age is approximately the same for all the judoka categories, and that there is a great range in the body height and body mass between the categories of the participants.

In addition, the ranges for all the parameters of motor potential within each of the studied categories of competitors are great.

Table 2 Differences of 3 groups of judokas (ANOVA method)

Parameter	Sum of Squares	Mean Square	F	Sig.
BM	5.797,944	2.898,972	67,933	0.000
BH	1.309,069	654,534	22,692	0.000
ASE	46.166,574	23.083,287	4,408	0,018
CMJ	167,354	83,677	2,082	0,137
T_TEST_LEFT	2,493	1,247	4,195	0,021
T_TEST_RIGHT	2,092	1,046	3,277	0,047
LR1	1.013	506,747	10,439	0,000
LR2	891,919	445,959	8,286	0,001
DR1	1.378,036	689,018	12,533	0,000
DR2	1.170,970	585,485	9,614	0,000
Vmax	18,195	9,098	4,194	0,021
VO2max	95,888	47,944	4,421	0,018

Analyzing the data in table 2 it is clear that there is a statistically significant difference in all the studied parameters of motor potential, except in explosive strength (CMJ height).

Based on the obtained results shown in table 3, it is clear that there are statistically significant differences between the categories of judokas weighing up to 60 kg and up to 73 kg in body mass (BM-p=.000), and body height (BH-p=.001), agility (T_TEST_LEFT-p=.025) and (T_TEST_RIGHT-p=.042), in the handgrip strength (RH1-p=.023) and (RH2-p=.024).

There are statistically significant differences between categories of judokas weighing up to 60 kg and exceeding 73 kg in body mass (BM-p=.000), and in body height (BH-p=.000), handgrip strength (LR1-p=.000), (LR2-p=.001), (DR1-p=.000) and (DR2-p=.000).

Between the categories of judokas weighing up to 73 kg and exceeding 73 kg there are statistically significant differences in body mass (BM-p=.000), and in body height (BH-p=.003), abdominal strength and endurance (p=.017), handgrip strength (LR1-p=.017), (DR1-p=.020), the greatest running speed (V2MAX-p=.033), and oxygen uptake (VO2MAX-p=.028).

Table 3 Differences of judokas between categories (MANOVA method)

Dependent variables	(I) category	(J) category	Mean difference (I-J)	Sig.
BM	Up to 60	Up to 73	-15,75000(*)	,000
	Up to 60	Exceeding 73	-30,14242(*)	,000
	Up to 73	Exceeding 73	-14,39242(*)	,000
BH	Up to 60	Up to 73	-8,05000(*)	,001
	Up to 60	Exceeding 73	-14,35879(*)	,000
	Up to 73	Exceeding 73	-6,30879(*)	,003
ASE	Up to 60	Up to 73	-14,50000	1,000
	Up to 60	Exceeding 73	56,11515	,171
	Up to 73	Exceeding 73	70,61515(*)	,017
CMJ	Up to 60	Up to 73	-4,76727	,143
	Up to 60	Exceeding 73	-2,91958	,756
	Up to 73	Exceeding 73	1,84770	1,000
T_TEST_ LEFT	Up to 60	Up to 73	,55591(*)	,025
	Up to 60	Exceeding 73	,51903	,062
	Up to 73	Exceeding 73	-,03688	1,000
T_TEST_ RIGHT	Up to 60	Up to 73	,53409(*)	,042
	Up to 60	Exceeding 73	,35691	,356
	Up to 73	Exceeding 73	-,17718	1,000
LR1	Up to 60	Up to 73	-5,68182	,097
	Up to 60	Exceeding 73	-12,46667(*)	,000
	Up to 73	Exceeding 73	-6,78485(*)	,017
LR2	Up to 60	Up to 73	-6,54545	,059
	Up to 60	Exceeding 73	-11,84848(*)	,001
	Up to 73	Exceeding 73	-5,30303	,109
DR1	Do 60	Up to 73	-7,63636(*)	,023
	Up to 60	Exceeding 73	-14,69091(*)	,000
	Up to 73	Exceeding 73	-7,05455(*)	,020
DR2	Up to 60	Up to 73	-8,00000(*)	,024
	Up to 60	Exceeding 73	-13,58182(*)	,000
	Up to 73	Exceeding 73	-5,58182	,114
VMAX	Up to 60	Up to 73	-1,11364	,139
	Up to 60	Exceeding 73	,19697	1,000
	Up to 73	Exceeding 73	1,31061(*)	,033
VO2MAX	Up to 60	Up to 73	-2,56773	,121
	Up to 60	Exceeding 73	,43521	1,000
	Up to 73	Exceeding 73	3,00294(*)	,028

DISCUSSION

Judo belongs to the group of polystructural acyclical sports which are dominated by acyclic movement, where the motion is performed and limited by direct confrontations with the opponent. What is characteristic of judo are the variety and number of technical elements, tactics, movements of the whole body and extremities in various directions with varying strength and tempo. During a judo match dynamic situations change all the

time, with changes in the position of both opponents, which requires good dynamic stereotype moves, combinations and throws, but also a good ability to effectively and quickly perform the reorganization of these dynamic stereotypes that is the constant creation of new programs, attacks and counter-attacks during a match. Judo is characterized by a large number of techniques and their complexity, which requires judokas to acquire large amounts of information which enable them to note important elements of technique so as to predict the opponents intentions and react in an adequate manner.

The functional abilities of judokas must be specifically pronounced due to the increased energy consumption during a single match and relatively long-term activity. Without well-developed functional abilities, it is not possible to achieve a good result at tournaments and individual championships, where during one day of competition a judoka fights several times. Modern-day judo requires a match to flow in a relatively short period of time, with a quick tempo, and to be full of numerous technical-tactical elements. Elite judokas must have all-around skills, and must have several moves in their repertoire - "specialty moves" from various groups of techniques, different tactics for each move, as well as for matches with various opponents. This kind of complex activity of the judoka during a match requires adequate abilities and skills, that is, appropriate dimensions of psychosomatic status.

The results of this study indicate statistically significant differences between the categories of judokas weighing up to 60 kg and categories of up to 73 kg and between categories of 60kg and above 73kg in agility and handgrip strength.

Agility is a multi-dimensional ability, which is relatively genetically conditioned (Bompa, 1999). Some researchers believe that the development of that ability is the most important prepubescent period (the sensibility phase) and the period of time immediately following the phase of rapid bodily growth. Agility is connected with the performance of specific technical-tactical structures and the level of muscle development, ligaments and the skeletal system. The realization of the speed of movement change is predominantly dependent on the plyometric muscle regime, which requires a high quality ligament-muscle apparatus (Radcliffe & Farentinos, 1999). According to the studies of Bompa (1999); Graham (2000) agility is one of the most important motor skills, which influence the results in many sports, including judo.

Judokas belonging to the up to 73kg category performed agility tasks more slowly in comparison to judokas of the up to 60kg category, which is somewhat justified since judokas of the categories up to 73kg have greater body height and body mass, and increased values of these parameters can slow down the task performance.

Results showed statistically significant difference in maximum oxygen uptake between the categories of judokas up to 73 kg and judokas exceeding 73 kg, which could be compared in some way to the results obtained by Patrik et al. (2015).

Between the categories of judokas weighing up to 60 kg and categories exceeding 73 kg, between the categories of judokas up to 73 kg and judokas exceeding 73 kg and categories of judokas up to 60kg and 73kg, there are statistically significant differences in the handgrip strength. These indicators are also a logical consequence of differences between physical parameters and the training process of judokas which is very complex. In training conditions, various forms of resistance are overcome due to the preparations of the locomotor composition for competition. Strong abilities include all those neuromuscular characteristics which enable the successful overcoming of resistance. The successful overcoming of resistance can be considered in the training and competitive sense. Competitive conditions

offer a number of situations in which strong features should enable the overcoming of resistance which is focused on achieving sports results. Strength and strong features include a large number of characteristics which are reflected during various body bends used to overcome external resistance or the load of one's own body (mass) which is especially pronounced in judo. In some movements and motion it is important to overcome certain resistance, irrespective of the time which is needed for the movement. In that case we are dealing with the manifestation of strength, while in the case of other movements and types of motion it is very important to overcome resistance in as short a time span as possible – in that case we are dealing with a manifestation of strength (Zatsiorsky, 1995).

CONCLUSION

The results obtained in this study contribute to the better understanding of the differences between motor potential of young Slovenian judokas in relation to three weight categories: -60 kg, -73 kg and +73 kg. The research has given an answer to the question of statistically significant differences in motor potential in relation to the competitive category of potential judo national team members of Slovenia.

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MOTORIČKI POTENCIJAL MLADIH DŽUDISTA SLOVENIJE

Istraživanje je sprovedeno sa ciljem da se utvrdi nivo motoričkog potencijala i razlike između 3 grupe džudista (kategorije do 60 kg, do 73 kg i iznad 73 kg). Uzorak istraživanja sačinjavalo je 181 džudista, potencijalnih reprezentativaca Slovenije kadetskog i juniorskog uzrasta 13 do 16 godina. U proceni motoričkog potencijala utvrđena je snaga stiska šake, snaga i izdržljivost abdomena, agilnost, izdržljivost i eksplozivna snaga nogu. Testiranje motoričkog potencijala sprovedeno je pomoću mobilne laboratorije sportsko konsultantskog udruženja iz Slovenije i Džudo Saveza Slovenije. Na osnovu dobijenih rezultata zaključeno je da postoje statistički značajne razlike u parametrima motoričkog potencijala između sve tri ispitivane kategorije džudista. Posebno je istaknuto da su džudisti kategorije do 60 kg slabiji u snazi šake i agilnosti u odnosu na kategorije džudista do 73kg i iznad 73 kg.

Ključne reči: motoričke sposobnosti, takmičarske kategorije, džudisti.