

Effects of Basic Preparation Period at Motor and Functional Abilities of Bosnia and Herzegovina Female Judokas

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Abstract

Aim of the research is to determine the effects of the three-week-long training period at the motor and functional abilities of the top female judokas. Sample consisted of 13 female judokas (age: 19.1 ± 5.1 , height: 167.5 ± 14.4 cm, weight: 64.3 ± 7.3 kg), members of the Bosnia and Herzegovina national team. Judokas training experience was 8 ± 2.4 years. Motor and functional abilities were tested. Functional abilities show statistically significant difference in variables *Heart frequency in the first minute of recovery* at the level $p < 0.001$. In parameters of *Anaerobic threshold heart frequency* and *Relative maximal oxygen uptake* we noticed also statistically significant differences at level $p < 0.05$. Variables for the assessment of the general motor abilities show high and statistically significant difference. The difference is most pronounced in the variables for the assessment of simple movements and flexibilities of the hamstring muscle, where the result was significantly lower at the final measurement ($p < 0.001$). Variables of *Explosive strength of lower extremities* and *Shoulder flexibility* show difference at level $p < 0.01$. While variable *plyometric endurance* has the significance of $p < 0.05$. Variables for the assessment of Lower extremities strength show statistically significant differences in *Maximum angular momentum of the left leg knee extensor* ($p < 0.01$) and *Maximum angular momentum of the left leg knee flexor* ($p < 0.05$). After applied training program female judokas improved values of relative maximum oxygen uptake and heart frequency in third minute of the recovery. Program improved lower extremities explosive strength and plyometric endurance. Basic preparation period program also produced optimal balance between left and right leg and also between knee flexors and extensors.

Key words: **$VO_{2\max}$, isokinetics, anaerobic alactic power**

Introduction

Nowadays top level sport results are achieved by the especially talented athletes, with continuity of hard work, quality coach, and any available material, organizational and science support (Gambetta, 1989). Motor abilities are the aspects of motor activities appearing in movements described by equal parameter system, measured by identical group of measures, and in which physiological, biological and physiological processes (mechanisms) appear (Zaciorski, 1975). Basic task of the methods of physical exercising or so called conditioning in athletes training is the development and maintenance of the motor abilities defined as: speed, endurance, strength, flexibility, coordination, balance, precision. Previous research in motor abilities confirmed that this segment can't be explained by one or few latent dimensions, rather it is the complex structure of quantitative (strength, speed, endurance) and qualitative (coordination, flexibility, balance, precision) characteristics (Jukić, 2003) or it is hierarchically organized system of abilities. Functional abilities represent efficiency of human body energy processes, and relates to efficiency of

Sažetak

Istraživanje ima za cilj da utvrdi efekte tronedeljnog trenažnog tretmana na motoričke i funkcionalne sposobnosti vrhunskih džudistkinja. Uzorak ispitanika je činilo 13 djevojaka (19.1 ± 5.1 godina, 167.5 ± 14.4 cm, 64.3 ± 7.3 kg), reprezentativki Bosne i Hercegovine u džudou. Sportski staž ispitanica iznosio je 8 ± 2.4 godina. Testirale su se motoričke i funkcionalne sposobnosti.

Kod varijabli funkcionalnih sposobnosti uočava se razlika statistički značajna kod *Srčane frekvence u 1. minutu oporavka* gde je na nivou procjene od $p < 0.001$. Kod parametara *Srčana frekvencija na anaerobnom pragu* i *Relativna maksimalna potrošnja kiseonika* uočene razlike su takođe statistički značajne ali na nivou od $p < 0.05$. Kod varijabli za procjenu opšte motorike primjetna je visoka i statistički značajna razlika. Ta je razlika najizraženija kod varijabli za procjenu brzine jednostavnih pokreta i gipkosti zadnje lože buta, gde je rezultat znatno lošiji na finalnom mjerjenju ($p < 0.001$). Kod varijabli *Eksplozivna snaga nogu* i *Gipkost ramenog pojasa* razlika je na nivou zaključivanja $p < 0.01$. Dok je kod varijable *Izdržljivost u skoku* ta značajnost na nivou zaključivanja $p < 0.05$. Kod varijabli za procjenu snage donjih ekstremiteta prisutne su statistički značajne razlike kod varijabli *Maksimalni obrtni momenat ekstenzora koljena lijeve noge* ($p < 0.01$) i *Maksimalni obrtni momenat fleksora koljena lijeve noge* ($p < 0.05$). Džudistkinje su nakon primenjenog trenažnog tretmana poboljšale vrijednosti relativne maksimalne potrošnje kiseonika i srčanu frekvenciju u trećem minutu oporavka. Tretman je pozitivno djelovao na eksplozivnu snagu nogu i izdržljivost u skoku. Takođe je nakon priprema ostvaren optimalan balans, kako između lijeve i desne noge, tako i između fleksora i ekstenzora koljena.

Ključne riječi: **$VO_{2\max}$, izokinetika, anaerobna alaktatna snaga**

aerobic and anaerobic functional mechanisms. Each sport can be described by domination of energy mechanisms. Very often in the context of physical training, endurance and functional abilities are mentioned. Such connection is logical considering that the energetic capacities are the prerequisite for endurance manifestation. Functional endurance training characterizes the stimulation and efficiency increase of aerobic and anaerobic energy mechanisms, primarily through the improvement of cardio respiratory system function and metabolic (anaerobic and aerobic) muscle cell functions.

Good realization of basic preparation build basis for the maximal physical preparation of female judokas and ensure high sport results. First mezocycle comprehended three microcycles which lasted 21 day in total and divided in two phases. In the first two microcycles prevailed the basic preparation, while in third microcycle emphasis was at the specific preparation.

Aim of the research is to determine the effects of the three-week-long training period at the motor and functional abilities of the top female judokas.

Methods

Sample of the examinees

Sample consisted of 13 female judokas (age: 19.1 ± 5.1 , height: $167,5 \pm 14.4$ cm, weight: $64,3 \pm 7,3$ kg), members of the Bosnia and Herzegovina national team. Judokas training experience was $8 \pm 2,4$ years.

Sample of the variables

Functional abilities

- Heart frequency in third minute of the recovery (bpm)
- Heart frequency at anaerobic threshold (bpm)
- Maximal heart frequency (bpm)
- Heart frequency in first minute of the recovery (bpm)
- Relative maximal oxygen uptake-VO₂kg (ml/min/Kg)

Basic motor abilities

- Shoulder flexibility (cm)
- Simple movement speed (s)
- Lower extremities explosive strength (cm)
- Plyometric endurance (cm)
- Sit and reach (cm)

Maximum angular momentum of the knee extensors and flexors

- Maximum angular momentum of the left knee flexors
- Maximum angular momentum of the left knee extensors
- Maximum angular momentum of the right knee flexors
- Maximum angular momentum of the right knee extensors

Procedure

Before the testing each examinee received details instruction on protocol of testing. Maximal oxygen uptake (VO_{2max}) was determined by the continually progressive treadmill test. Treadmill test (Cosmed T 150) started with three minute walk at speed of 3 km/h, and than each minute speed increased for 1 km/h up until the examinee voluntarily gave up. Treadmill inclination was constantly at 1.5°. Exhaled air was collected and analyzed using COSMED Quark b² (Italy) breath-by-breath gas system of the exchange. Heart beats were measured by short range radio telemetric system (Polar, Finland). These cardio respiratory values were calculated automatically through the software and printed each 30 seconds. Critical moment for the assessment of the maximal oxygen uptake (VO_{2max}) was the moment when the VO₂ reached the maximum. The top values were calculated as arithmetic mean of the two consequent 30-seconds top value.. Anaerobic threshold (Tvent) was determined non - invasively from the gas exchange parameters. Systematic exchange of the respiratory equivalent for the VO₂ (VE/VEO₂) without the increase

in respiratory equivalent for the CO₂ (VE/VECO₂) was used as a anaerobic threshold marker.

Reaction speed was measured by a reaction-meter of the French manufacturer EAP consisting of stimulator with display and switch handle grip. Contact mat (Ergo-Jump, Bosco System, Italy) was used to measure the explosive strength of the lower extremities and plyometric endurance. Explosive strength of the lower extremities was determined by the squat jump (SJ) mean value. Anaerobic alactate strength was determined by the 15 seconds vertical jumps.

For isokinetic testing we used, Easytech prima DOC“ isokinetic dynamometer. Before each test the apparatus was calibrated. The motion range of tested extremity was 90 degrees. The same person gave the instruction and conducted the testing. The dynamometer seat was set for each examinee so that the knee would be in the projection of the joint line. The immobilization of the examinees was done by use of belts, in order to perform the certain group of muscles motion (thigh extensor or flexor). Testing started with worm-up, with a rest period of 2 minutes before the execution of the maximal contractions. Testing of the maximal muscle contraction was performed at angular velocities of 60°/sec. Four consequent contractions were performed. Apparatus noted following vales: peak torque, peak torque as body mass percentage, maximum work, and total work as a body mass percentage. Same procedure was applied at the right and left leg (Madsen et al.,1996, Gleeson et al., 1996).

Conditioning program

First part of the preparation consisted of 14 training days. Basic task was the increase of the motor and functional abilities level. It consisted of 18 training units in total. Weight room trainings (9) where intended for the development of the repetitive and explosive strength. Exercises used where bench press, snatch and clean, half squat and lounge. Method was circular training. Other trainings where aerobic (6) and anaerobic (3). In the next 7 day area we tried to increase was the specific working ability through the specific judo motor ability.

Data processing

Data were processed by the use of the statistical program package - Statistical Package for Social Science (SPSS). Differences between two measurements were calculated by the use of Paired-Samples T Test.

Results

Pairs of the variables analyzed by the t-test, show differences between initial and final measures in functional abilities of female judokas (Table 1).

Table 1. Effects of the three-week-long training period at the cardio vascular and respiratory system of the top female judokas members of the Bosnia and Herzegovina national team. (N=13)

Variable	Measure	AS	R	t	P
Relative maximal oxygen uptake-VO ₂ kg (ml/min/Kg)	Initial	49,95	0,911	-2,422	0,032
	Final	51,41			
Heart frequency at anaerobic threshold (bpm)	Initial	183,23	0,898	2,379	0,035
	Final	181,69			
Maximal heart frequency (bpm)	Initial	192,92	0,893	1,795	0,098
	Final	191,62			
Heart frequency in first minute of the recovery (bpm)	Initial	152,31	0,111	-4,633	0,001
	Final	166,46			
Heart frequency in third minute of the recovery (bpm)	Initial	121,00	0,704	1,063	0,309
	Final	118,62			

In variables of the functional abilities the greatest difference is noticeable in *Heart frequency in 1. minute of the recovery* where the difference is statistically significant at the level of $p < 0,001$. Parameters *Heart frequency at anaerobic threshold* and *Relative maximal oxygen uptake- $\dot{V}O_{2kg}$* show differences statistically significant at $p < 0,05$.

Pairs of the variables analyzed by the t-test, show differences between initial and final measures in motorfunctional abilities of female judokas (Table 2).

Table 2. Effects of the three-week-long training period at the basic motor abilities of the top female judokas members of the Bosnia and Herzegovina national team. (N=13)

Variable	Measure	AS	R	t	P
Simple movement speed (s)	Initial	,2762	0,829	-5,592	0,000
	Final	,3254			
Lower extremities explosive strength (cm)	Initial	29,331	0,945	-3,541	0,004
	Final	30,331			
Plyometric endurance (cm)	Initial	23,669	0,785	-2,615	0,023
	Final	24,592			
Sit and reach (cm)	Initial	39,92	0,973	5,776	0,000
	Final	37,77			
Shoulder flexibility (cm)	Initial	69,00	0,980	3,271	0,007
	Final	67,15			

Variables for the assessment of the general motor abilities show high and statistically significant difference. The difference is most pronounced in the variables for the assessment of simple movements and flexibilities of the hamstring muscle, where the result was significantly lower at the final measurement ($p < 0,001$). Variables of *Explosive strength of lower extremities* and *Shoulder flexibility* show difference at level $p < 0,01$. While variable *plyometric endurance* has the significance of $p < 0,05$.

Pairs of the variables analyzed by the t-test, show differences between initial and final measures in isokinetic parameters functional abilities of female judokas (Table 3).

Table 3. Effects of the three-week-long training period at the maximum angular momentum of the knee extensors and flexors of the top female judokas members of the Bosnia and Herzegovina national team. (N=13)

Variable pairs	Measure	AS	R	t	P
Maximum angular momentum of the right knee extensors	Initial	180,08	0,487	1,469	0,16
	Final	170,15			
Maximum angular momentum of the left knee extensors	Initial	187,69	0,682	2,960	0,01
	Final	170,77			
Maximum angular momentum of the right knee flexors	Initial	76,08	0,105	1,395	0,18
	Final	67,46			
Maximum angular momentum of the left knee flexors	Initial	74,38	0,413	2,167	0,05
	Final	66,23			

Variables for the assessment of Lower extremities strength show statistically significant differences in *Maximum angular momentum of the left leg knee extensor* ($p < 0,01$) and *Maximum angular momentum of the left leg knee flexor* ($p < 0,05$).

Discussion

After applied training program female judokas improved values of relative maximum oxygen uptake and heart frequency in third minute of the recovery. The significance of the aerobic capacity for the high level result achievement in judo research showed as contradictory. While some authors (Borkowsky et al., 2001; Franchini et al., 2005) did not found significant differences between elite and non-elite judokas, other researches (Muramatsu et al., 1994; Gariod et al., 1995) found that the aerobic capacity has the positive influence at exercises with stops in high level intensity. This is acceptable because Muramatsu et al. (1994) found high correlation between aerobic capacity and total work in 10 seconds supra-maximal effort with 55 seconds intervals

at 80% of $\dot{V}O_{2max}$, as well as total work of 10 seconds of supra-maximal efforts with 20 seconds intervals at 80% of $\dot{V}O_{2max}$. Research showed that judokas with higher $\dot{V}O_{2max}$ show faster CP-a re-synthesis (Gariod et al., 1995) in relation to competitors with lower level of $\dot{V}O_{2max}$. This can be significant for the tasks with time outs, as in judo where the athlete must perform multiple high-intensity tasks with less time to recover. It has been established (Muramatsu et al., 1994; Castarlenas et al., 1997) that the judo competitors with higher level of the $\dot{V}O_{2max}$ will be in advantage in match with maximal duration (5 minutes), because the total supra – maximal load will have lower relative intensity in comparison with the competitor with lower level of $\dot{V}O_{2max}$. Judokas in recovery will be aided by higher aerobic capacity, besides the faster lactate removal and pH value recovery.

In variables of the general motor ability assessment there is a high and statistically significant positive difference in the area of explosive strength of the lower extremities and plyometric endurance. The performance of the squat jump depends mostly of the muscle contractibility, it can be presumed that the ability to apply maximal strength in eccentric-concentric cycle(SSC)

in judo is more important than sheer maximal strength applied through concentric movement. Judo match lasts 5 minutes, and with time outs up to 9 minutes. It represents high-intensity effort of the anaerobic type and by the most of the researches dealing with match structure (Sikorski et al., 1987; Castarlenas and Planas, 1997; Svischev, 2001; Kahabrishvili et al., 2003) it consists of 12 to 15 active fight segments (10-30 seconds) with rest between them (10-15 seconds). Activity of this nature sets high requests at both aerobic (lactate and alactate) performance abilities. Therefore the short-term anaerobic capacity is of great importance in judo. Sit and reach test showed worst results in final measurement so it is recommended to improve program with flexibility exercises as an important part of the good judokas preparation.

After applied treatment changes occurred at the thigh muscle strength in judokas. Isokinetics diagnostics showed the results based at we can conclude that at the initial measurement judokas had imbalance between antagonistic muscle groups of the thigh, related to the bilateral difference. Difference at the level of 10% does not disturb the sport performance and has no risk of sport injuries (Ostering, 1983; Dvir, 1995). Results achieved by female judokas confirm results of earlier investigations conducted at the similar sample (Heitkamp et al., 2002) where authors suggested applying the balance board training in order to repair the mentioned irregularities. This way of the neuromuscular training would enable quick improvement in our female judokas considering the need for fine dynamical stereotype remodeling. Applied training treatment at female judokas also produced optimal balance between left and right leg and also between knee flexors and extensors.

Conclusion

Author of this paper considers that the adequate aerobic endurance is necessary for the quick recovery between time outs in match and matches. High aerobic capacity insures faster recovery during and after training. Also it is known that fast recovery enables reduction of rest and continue with higher intensity, especially in sports requiring multiple repetition of the sport specific knowledge (technique, abilities)

The reason why there were no greater improvement after this preparation period, are the results of additional strength training which female judokas had during last years. It is necessary to include additional trainings in order to improve flexibility of the lower back and hamstring muscle.

Judokas that do not fit the ideal profile can succeed through the improved and superior technique and tactic knowledge.

References

Borkowsky, L., Faff, J., Starczewska-Czapowska, J. (2001). Evaluation of the aerobic and anaerobic fitness in judoists from the Polish national team. *Biol Sport*, 18, 107–111.
Castarlenas, J.L., Planas, A. (1997). Estudio de la estructura temporal del combate de judo. *Apunts*, 47, 32-39.
Свищёв, И.Д. (2001). Теория взаимодействий: общие закономерности взаимодействий участников соревнований в единоборствах и спортивных играх. *Теория и практика физ. культуры*, 4, 39-43.
Dvir Z, David G. Average or peak moment: which of the two is the more suitable to represent isokinetic muscle strength? *Isokinetic Exer Sci*. 1995, 5: 93-7.

Franchini, E., Takito, M.Y., Kiss, M., Sterkowicz, S. (2005). Physical fitness and anthropometric differences between elite and nonelite judo players. *Biol Sport*, 22, 315–328.

Gambeta, V. (1989). *New trends in training theory*. NSCA, 4(3), 7-10.

Gariod, L., Favre-Juvin, A., Novel, V., Reutenauer, H., Majeau, H., Rossi, A. (1995). Evaluation du profit energetique des judokas par spectroscopie RMN duP31. *Sci Sports*, 10, 201–207.

Gleeson NP, Mercer TH. The utility of isokinetic dynamometry in the assessment of human muscle function. *Sports Medicine*. 1996, 21(1): 18-34.

Jukić, I. (2003). Osnove kondicijskog treninga. *Kondicijski trening*, 1(1), 4-8.

Кахабришвили З.Г., Ахалкаци В.Ю., Квиникадзе Д.Г. (2003). Использование специфических тестов для оценки функционального состояния борцов дзюдо. *Теория и практика физ. культуры*, 2, 36-37.

Heitkamp, H.C., Mayer, F., Fleck, M. i Horstmann, T. (2002). Gain in thigh muscle strength after balance training in male and female judokas. *Isokinetics and Exercise Science*, 10, 199-202.

Madsen OR. Torque, total work, power, torque acceleration energy and acceleration time assessed on a dynamometer: reliability of knee and elbow extensor and flexor strength measurements. *Eur J Appl Physiol*. 1996, 74: 206-10.

Muramatsu, S., Horiyasu, T., Sato, S.I., Hattori, Y., Yanagisawa, H., Onozawa, K., Tezuka, M. (1994). The relationship between aerobic capacity and peak power during intermittent anaerobic exercise of judo athletes. *Bulletin of the Association for the Scientific Study on Judo Kodokan*, 8, 151–160. [In Japanese with English abstract]

Ostering, L.R., Hamill, J., Sawhill, J. and Bates, B.T. (1983): Influence of torque and limb speed on power production in isokinetic exercise. *American Journal of Physical Medicine*, 62, 163 – 171.

Sikorski, W., Mickiewicz, G., Majle, B., Laksa, C. (1987). Structure of the contest and work capacity of the judoist. In: *International Congress Judo-Contemporary Problems of Training and Judo Contest Proceedings*. European Judo Union, Spala, 58-65.

Zatsiorski, V.M. (1975). *Fizička svojstva sportiste*. Beograd: SFKJ.

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