

THE EFFECTS OF PREPARATION PERIOD TRAINING PROGRAM ON MUSCULAR STRENGTH OF FIRST-CLASS JUDO ATHLETES

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Higher demands which characterize modern judo and analysis of many novelties in the area of periodizations have the aim to enable better training effects and to overcome empiric and disorganized work of coaches by varying different methodical training parameters and characteristic situational judo training. Strength training is a form of physical activity used for increasing abilities of surmounting or resisting the power. The increasing in muscular strength results in increased success in performing some motoric tasks. In our research, estimation of selected judo athlete muscular strength is done by combination of laboratory and field tests. The research was conducted in two phases during the 10-week preparation period. The obtained results showed statistically significant high values of muscular strength in most tests. That is why we concluded that the applied preparation strength training resulted in increasing muscular strength in judo athletes. We think that the right periodizations of training enable adequate functional adaptation of judo athletes. Strength training applied in preparation period will lead to adequate increasing in muscular strength of judo athletes which make basis for faster performing of movements and efficient performing of techniques during a match. *Acta Medica Medianae 2008;46(4):22-26.*

Key words: judo, training, periodization, strength

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Introduction

The success in judo represents the result of many components mutually united in unique activity, i.e. the sum of anthropometrical, motoric, functional, cognitive, conative and other factors (1). The establishing of: motoric, situation-motoric and morphological characteristics are important factors in the process of sport selection and designing the models on which training process of judo athletes are programmed. The relation between basic motoric abilities, morphological characteristics and motoric skills are always multidimensional and complex. It is considered that high level of basic motoric abilities is a main prerequisite for efficient learning of new motoric structures, its improvement and successful usage (2). In the training process, a dominant aim is transformations of basic motoric abilities and some morphological characteristics. However, all basic motoric abilities are not change-

able at the same level, and besides being deeply ingrained in organized system of other anthropological dimensions, it is very hard to change them independently and one by one in a desired direction. That is the reason why there is no universal, unique training system which can assure such level of basic motoric abilities and which suits to all possible types of movements (3).

Muscular strength represents the ability of muscle or muscle group to overcome the loading. Muscular endurance is the ability of the muscle group to make repetition of contraction in certain time interval and this action is enough to provoke muscular fatigue or maintain specific percent of maximal voluntary contraction during longer time interval (4). Strength training is a form of physical activity which is used for increasing abilities of surmounting or resisting to the power. The increasing of muscular strength results in increased success in performing of some motoric tasks (5). That is very important considering the fact that modern judo demands short fight, fast tempo and many tactic-technique elements (6,7).

In order to reach the aim it is necessary to hold on to basic rules of training periodizations. Plan of training process during a year is based on periods, phases and micro cycles (8,9). They are determined by specifics of judo, by individual

abilities, years of competitors, competition calendar, and also by the aims set in macrocycles. Higher demands which characterize modern judo and analysis of many new things in area of periodizations have the aim to enable better training effects and to overcome empiric and disorganized work of coaches by varying different methodical training parameters and characteristic situational judo training. Periodizations of strength training is performed through following stages: functional adaptation, phase of developing muscular strength and endurance, maintaining phase and compensation phase (4,5). The aim of functional adaptation is to prepare muscles, ligaments, strings and ankles for long and tiring training phases. During this phase, athletes exercise 4-6 weeks with loading 40-60% from maximum and repeat cycles 8-12 times in 2-3 series. The next phase develops maximal muscular strength with increasing of muscular endurance. Considering the specifics of judo sport, which has its demands to develop both maximal strength and endurance equally, training should be adjusted. The aim of the maintaining phase is to maintain the levels which are achieved in previous phases. The aim of the compensation phase is to eliminate fatigue and regenerate power source by active relaxation.

Methods

The research was performed on the sample of 20 young highly selected judo athletes of cadet age, who ensured its place on the list of potential competitors in national team for European youth olympic festival (EYOF 2007), European championship and Balkan championship by winning medals on national championship. All of the subjects were informed about the relevant information in written form regarding the aims, course, participation and possible unwanted side effects of the research. All the subjects voluntarily gave their written consent to participate in the study, and underwent a general physical examination.

Muscular strength is specific for the contraction type, static or dynamic, concentric or eccentric, isokinetic or isoinertial, speed of contraction and angle of the tested ankle. That is the reason why there is no universal estimation for establishing muscular strength of whole body (10). In our research, the estimation of selected judo athletes muscular strength was done by combination of laboratory and field tests. The research was conducted in two phases over the 10-week preparation period (initial and final test). The laboratory testing was carried out by Wingate anaerobic test (11). For this purpose, an arm cycle ergometer (Monark, Sweden) equipped with electronic measuring device with display was used. The setting up of the equipment and the subjects' warm-up were carried out according to the standard (11,12). Data registration was carried out with the help of a specially designed computer program on the basis of the standards

devised by the author of the test and the published technical description of a system for registering data by means of a computer (13). The Wingate test was carried out in the morning hours, at least 16h after the last training, in a room where the temperature was 21-23°C, where the humidity was 55-60%, so that the microclimatic conditions followed the standards for functional lab testing (14,15). For the estimation of muscular strength, field testing for performing functional movements were used: distant jump, triple jump and vertical jump. Muscular endurance was estimated by methods of performing functional movements: push-ups, abdominal strength test (curl-ups) and reverse chin-ups. Because there were several different variants of those tests, in our research we used modern precise standardized protocols (15,16,17). The aforementioned protocols had precise warm up activity to prevent injuries. Shapiro - Wilks Test was used for testing normal distribution of measured tests. In order to process the results of the study, the SPSS statistical program for Windows (Release 10.0, Chicago, IL, USA) was used and $p < 0.05$ was used as the accepted level of significance.

Results

The results of muscular strength and muscular endurance are presented in Tables 1 and 2. All results are presented as means \pm SD.

Table 1. The estimation of muscular strength of judo athletes (n=20) by laboratory and field testing

Muscular power	Initial test	Final test	p value
Peak power (W)	615,46 \pm 62,78	648,14 \pm 64,14	$p < 0.05$
Peak power (W \cdot kg ⁻¹)	9,14 \pm 1,02	9,63 \pm 0,9	$p < 0.05$
Distance jump (cm)	209,91 \pm 19,3	237,17 \pm 19,84	$p < 0.05$
Triple jump (cm)	639,72 \pm 46,06	651,76 \pm 39,4	$p > 0.05$
Vertical jump (cm)	47,63 \pm 5,7	55,29 \pm 7,6	$p < 0.05$

Table 2. The estimation of muscular endurance of judo athletes (n=20) by laboratory and field tests

Muscular power	Initial test	Final test	p value
Mean power (W)	446,21 \pm 50,52	453,36 \pm 49,86	$p > 0.05$
Mean power (W \cdot kg ⁻¹)	6,64 \pm 0,88	6,73 \pm 0,76	$p > 0.05$
Push-ups (repetition)	40,04 \pm 7,93	38,94 \pm 6,9	$p > 0.05$
Abdominal strength test (repetition)	35,75 \pm 4,1	35,76 \pm 3,34	$p > 0.05$
Reverse chin-ups (repetition)	14 \pm 5,07	15,64 \pm 5,1	$p > 0.05$

Discussion

Reproduction of muscular strength is mostly determined by morphological and physiological

factors of bone-muscle tissue and ankles of every subject. The effects of the training with load mainly relate to adaptation of contractile structures, which increase muscular strength. Researches also noticed the existence of relations between showing strength and speed of muscular contraction (18). The increasing of muscular strength has positive effect on speed of movement (19). Fast adaptation of the nervous system explains fast and significant advance in muscular strength during early phases of training (20,21). Changes inside the muscles are insignificant yet, because there is no increasing of volume or surface of muscle cross section. The complexities of training also determines the direction of neuromuscular adaptation. Relatively simple muscular activities, in comparison to complex movements, show very fast neuromuscular adaptation in early training phase followed by increasing of strength and muscular hypertrophy in later phases. Complex actions which include more ankles, wrists and muscles, demand more time for neuromuscular adaptation (23).

Measuring of muscular strength is used to: estimate muscular ability, identified weaknesses, measure effectiveness of training and track the increasing of rehabilitation (10). Tests of muscular strength and endurance are very specific for tested muscle group, type of contraction, speed of muscular movement, type of equipment and range of ankle movement. The results of any single test are specific for used procedures, and there is no single test for estimation of muscular endurance or muscular strength of the whole body (14,16).

Unfortunately, there are a few tests measuring endurance and strength which control lasting of repetition or movement range that is the reason why it is hard to interpret the results. All examinees included in our research were introduced with the equipment and specific protocols. By this we provide the results which can be used for tracing real physiological adaptation through time. Given results show statistically significant high values of muscular strength in most tests ((peak power 615,46W±62,78 pre vs. 648,14±64,14 post; $p<0.05$); (distance jump 209,91cm±19,3 pre vs. 237,17cm±19,84 post; $p<0.05$); (vertical jump 47,63cm±5,7 pre vs. 55,29cm±7,6 post; $p<0.05$)). That is the way how we can conclude that used preparation strength training resulted in increasing the muscular strength of judo athletes. Given results show no statistically significant changes of muscular

endurance ((mean power 446,21W±50,52 pre vs. 453,36W±49,86 post; $p>0.05$); (push-ups 40,04 repetition±7,93 pre vs. 38,94repetition ±6,9 post; $p>0.05$); (abdominal strength test 35,75 repetition ±4,1 pre vs. 35,76 repetition ±3,34 post; $p>0.05$); (resverse chin-ups 14 repetition ±5,07 pre vs. 15,64 repetition ±5,1 post; $p>0.05$)). As it is known, muscle fiber during strength training in longer time period react in the way that the amount of contractile proteins in them increase at the same time with components which generate energy (24), but during that phase there is no parallel increasing of capillary number, volume of mitochondria and theirs enzymes (25). It is obvious that there is violation of concentration of myofibril proteins and mitochondria that is mitochondria enzymes on behalf of the first ones (26). This response of the body on training won't disturb showing of muscular strength in activities because of anaerobic nature of this activities. However, it is possible that the effect on endurance is shown because of enlarged trainings and decreasing of aerobic capacity on unit of muscular strength (27).

Such result of training process is not needed, considering duration of the match, 5 min, and significant aerobic demands between matches in row. That is the reason why the training process in judo demands optimal relation of strength training, aerobic trainings and improving technical – tactical elements. We think that strength training applied in preparation period will lead to adequate increasing of muscular strength of judo athletes which make basis for faster performing of movements and efficient performing of techniques during match. Improvement of the aforementioned elements makes competitor's advantage over its opponent.

Conclusion

Right periodizations of training enable adequate functional adaptation of judo athletes. Performing of strength training as a part of training process of preparation period causes increasing in muscular strength. The used program can serve as the basis for planning and programming or training process of judo athletes. In that way we can achieve higher level of physical activities during the most important competitions in one year. The tests used for the estimation of muscular strength and muscular endurance can be labeled as standards for further researches and comparisons of effects of applied trainings.

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EFEKTI TRENAŽNOG PROGRAMA PRIPREMNOG PERIODA NA MIŠIĆNU SNAGU VRHUNSKIH DŽUDISTA

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Povećani zahtevi koji karakterišu moderni džudo i analiza brojnih noviteta u području periodizacije imaju za cilj da se, variranjem različitih metodičkih parametara treninga i karakterističnim situacionim treningom džudoa, omogući bolji trenažni efekat i prevaziđe dosadašnji empirijski i stihijski rad trenera. Trening snage je oblik fizičke aktivnosti koji se koristi za povećanje sposobnosti savladavanja ili opiranja sili. Povećanje mišićne snage rezultuje povećanom uspešnošću u izvođenju određenih motoričkih zadataka. U sprovedenom istraživanju, procena mišićne snage i mišićne izdržljivosti 20 mladih, visoko selekcionisanih džudista vršena je kombinacijom laboratorijskih (Vingejt anaerobni test) i terenskih testova (izvođenje funkcionalnih pokreta). Testiranja su vršena na početku pripremnog perioda i nakon 10 nedelja, na kraju pripremnog perioda. Prikazani rezultati pokazuju statistički značajno veće vrednosti ispoljene mišićne snage u većini korišćenih testova. Nema statistički značajnih razlika u mišićnoj izdržljivosti, ni na jednom od primenjenih testova. Na osnovu dobijenih rezultata može se zaključiti da pravilna periodizacija treninga snage, kao dela trenažnog programa pripremnog perioda, omogućava adekvatnu funkcionalnu adaptaciju džudista, što rezultuje povećanjem mišićne snage uz nepromenenu mišićnu izdržljivost. *Acta Medica Medianae 2008;47(1):22-26.*

Ključne reči: džudo, trening, periodizacija, snaga