"IDO MOVEMENT FOR CULTURE. Journal of Martial Arts Anthropology",
Vol. 18, no. 3 (2018), pp. 28–36
DOI: 10.14589/ido.18.3.5

KINESIOLOGY & COACHING

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Modelling Mixed Martial Arts Power Training Needs Depending on the Predominance of the Strike or Wrestling Fighting Style

Submission: 19.01.2018; acceptance: 18.06.2018

Key words: mixed martial arts, modelling of power training, manner of fighting, adaptive-compensatory reactions

Abstract
Purpose – to develop models for Mixed Martial Arts athletes power training, depending on the predominance of the strike or the wrestling style in fighting, and also to determine the impact of the proposed training loads on increasing the functional ability of their bodies.
Methods. We examined 30 athletes aged 20-22 who were involved in Mixed Martial Arts fights over the last 2 years. Half the fighters use the strike style in the course of combat, and the rest specialise in the wrestling style. To assess the effectiveness of the occupation models we developed, we used the control testing method of the level of power capabilities development. With the help of the biochemical control of cortisol concentrations in the blood serum of the fighters, we determined the manifestation of adaptive-compensatory reactions of the body to various power loads.
Results. It was established that the optimal power loads for fighters using the strike style of fighting was to use a high-intensity regime when working with an alactate or lactate energy supply system. In turn, the most effective power loads, for the maximum realisation of functional potential in athletes prioritising the wrestling style during the fight, was the use of low-intensity regimes with a large amount of work in the glycolytic power supply system.
Conclusions. The analysis of the results obtained during the experiment demonstrates the need for using models of training sessions developed in the process of power training of MMA fighters, taking into account the particular fighting style.

Introduction

The current requirements for the training of Mixed Martial Arts fighters requires a fairly balanced integrated approach to modelling the training process, taking into account the individual functional capabilities of athletes, their level of tactical and technical training, stress resistance and many other factors that allow mobilizing all body reserves to achieve the maximum result [Del Vecchio *et al.* 2011; James *et al.* 2016; Matthews *et al.* 2017; Kozina *et al.* 2017].

Developing new models for improving the technical training of MMA fighters is one of the main, priority tasks in the correction of their training sessions, which according to the majority combat sports and martial arts specialists [Dudnyk *et al.* 2009; Korobeynikov *et al.* 2011, 2016; Latyshev *et al.* 2017; Podrigalo *et al.* 2017; Slimani *et al.* 2017; Sinnett *et al.* 2018] will not only improve the speed of improving the technical skills of athletes, but will also contribute to the optimisation of the training system as a whole. At the same time, taking into account the peculiarity of the MMA fighters when most of them (78.3%) use the most effective technical elements of one or two martial arts during fights, significantly limits the possibilities for tactical construction of the combat algorithm and reduces their chances of winning in comparison with athletes owning to a large number of technical arsenals. At the same time, leading

experts in this field of sports [James *et al.* 2016; Iermakov *et al.* 2016; Matthews *et al.* 2017] analysed the research results by indicating that effective tactics of fighting gives great advantages even for fighters who may be inferior in terms of technical training. These judgements cause great discussion among the athletes, the world's leading trainers, as well as among scientists in the field of sports, sports physiology and biochemistry.

The question concerning the development of models for training sessions aimed at increasing the speed-strength capabilities of MMA athletes' bodies and their strength endurance were extensively researched [Wiechmann *et al.* 2016; Ghoul *et al.* 2017]. At the same time, the solution to this problem was approached in the same way, using only the generally accepted training systems that are standard and take into account only the specific features of a particular kind of martial arts (wrestling, *sambo*, boxing, *taekwondo* and others) rather than the general system of physical training for MMA fighters [Wiechmann *et al.* 2016; Chernozub 2015; Ghoul *et al.* 2017]. At the same time, the problem of optimising the training process, taking into account the correction of loads aimed at improving the parameters of the physical training of the sportsmen, depending on the predominance of strike or wrestling style in fighting, has not been thoroughly studied by modern science.

Thus, the question of finding effective ways to increase the MMA athletes fighting styles remains poorly researched. In addition, there are no combined training session models for the physical training of fighters taking into account technical and tactical elements of various martial arts.

The aim of the study is to develop models for MMA athletes' power training depending on the predominance of the strike or wrestling style in fighting, as well as determining the impact of the proposed training loads on increasing the functional ability of their bodies.

The article is a fragment of the planned scientific research "Development and implementation of innovative technologies and the functional state correction of a person under physical stress in sports and rehabilitation", (No. State Reg. 0117U007145).

Methods

Participants

We examined 30 athletes aged 21±1.2 who were involved in Mixed Martial Arts fights over the last 2 years and going in for one of the martial arts for more than 10 years. For the reliability of the studies, the fighters were selected in such a way that the initial parameters of their anthropometric body indices did not have any significant differences. Thus, the average height indexes of participants in the studies were 175.3 ± 5.2 cm; body weight – 82,4 ± 4,3 kg; shoulder circumference – 38.4 ± 2.4 cm; the hip circumference – 55.3 ± 3.6 cm; and the neck circumference – 41.3 ± 1.9 cm. Taking into account the research objectives, 2 research groups were formed: group A consisted of 15 athletes who use predominantly strike style in fighting; group B included 15 fighters who have the wrestling manner of fighting.

The experimental study was approved by the Ethics Committees for Biomedical Research in accordance with the ethical standards of the Helsinki Declaration. Written consent to the research was given by the athletes according to the recommendations of the Ethics Committees for Biomedical Research.

The equipped and certified medical laboratory was used to provide a medical examination and a comprehensive biochemical laboratory control (16 indicators) of the MMA fighters taking part in experimental power training.

Measures

The initial level evaluation of maximal muscular strength development in the participants and the determination of the characteristic parameters of its dynamics during a long period of research were carried out using the method of control testing [Shaneret *et al.* 2014]. Using the technique of performing the bench press exercise in the Simoz-machine simulator [Chernozub 2015], common in power sports, after a warm-up, each athlete was given three attempts to determine the maximum parameters of the development of pectoral muscle strength. The result of the best attempt was written down into the protocol. The cortisol concentration in blood serum of the examined sportsmen was determined by the method of enzyme immunoassay under the conditions of a certified medical laboratory [Honour 2017; Sallam 2017]. Blood sampling was performed by a medical worker from sportsmen's veins before and after a training session with observance of all the norms. Blood samples were numbered, the necessary description was made and delivered to the clinical laboratory. Physiologically acceptable cortisol concentration in the blood serum of healthy people is in the range of 150-660 nmol /l.

Procedure

Representatives of group B used the model of training with the parameters of power loads completely resembling the "standard" training for power fitness during 3 months of training [Chernozub 2015]. At the same time, the members of group A used a completely different model of muscular activity compared to the above: the number of repetitions in the set decreased from 12 to 4, the rest period between sets decreased from 1-1.2 minutes to 40 seconds; the speed of performing exercises slowed down from 3 seconds to 9 during concentric and

eccentric phases of movement, and the total amount of training work was reduced by 50%. Training exercises were carried out with a barbell, dumbbells and on simulators while observing the technique we determined. The duration of one training session was no more than 40-50 min, regardless of the models of muscular activity which the representatives of the study groups used. Trainings were held 3 times a week.

All athletes who took part in the studies had undergone a medical examination and a comprehensive biochemical laboratory control (16 indicators), according to which they had no medical contraindications to participate in the studies.

The research proceeded in several stages:

— at the first stage, we developed experimental models of training sessions for both groups of athletes with the purpose of increasing the functional abilities of their bodies during 3 months of intensive physical training;
— at the second stage, we investigated the changes in the power capabilities of athletes, and the degree of adaptation-compensatory reactions during control fights with the same level of preparedness;
— at the third stage, in order to confirm our supposition, group A representatives used the model of training sessions developed individually for the fighters of group B. This continued during the next 3 months. At the end of this stage, control fights were also conducted. The training fight consisted of 3 rounds, 5 minutes each and was conducted in competition-like conditions.

The study of the development dynamics of the maximal muscular power of the participants took place within 6 months using well-known techniques. The control examination was carried out monthly.

Laboratory studies of blood serum of the examined athletes as to cortisol concentration were carried out before and after fights in several stages: at the beginning of the experiment; after 3 months of using individually developed models of training sessions; after a long use of training strength loads (3 months), which do not correspond to the manner of fight represented by the athletes of this group. The cortisol concentration in blood of the examined individuals was determined by the method of enzyme immunoassay in the conditions of a certified medical laboratory.

Statistical analysis

Statistical analysis of the study results was performed using the IBM * SPSS * Statistics 20 software package (StatSoftInc., USA). To calculate the mean and standard error of the mean, the median (Me), 25%, and 75% quartiles we used discrete statistics methods. A non-parametric Wilcoxon test was used to assess the validity of paired differences. Freedman's ANOVA was used to analyse repeated measurements.

Results

The results of studying the peculiarities of the change in the power capabilities of athletes based on the bench press test for both groups examined during all the stages of the experiment, under the conditions of using different models of training sessions, are shown in Fig. 1.

Analysis of the results showed that at the beginning of the research the initial level of the maximum strength development in the surveyed groups of fighters, regardless of the technical arsenal and fighting style prevalence as well as presence of special training in some kind of martial arts, had identical parameters. This circumstance allowed us to more accurately assess the effectiveness of the models of training sessions we developed on the dynamics of monitored indicators. Thus, the indicators of the maximum barbell weight (1PM), which can be overcome no more than once due to muscular efforts up to their full fatigue, were established among the representatives of group A at the level of 69.4 ± 2.3 kg, and among the athletes of group B – 70.2 ± 3.1 kg. The obtained results almost identical initial values of the monitored indicator allow us to more accurately assess the effectiveness of the proposed models of training sessions on the dynamics of body power capabilities of the surveyed sportsmen during a long period of research.

In the 3-month-course of the research it was established that using experimental models of power training positively influenced the dynamics of the studied indicators for participants of each of the surveyed groups.

At the same time, taking into account the fact that the majority of specialists dealing with power training of MMA athletes indicate the need of using "average" physical loads that will bring maximum effect for both groups of fighters [Slimani *et al.* 2017; Sinnett *et al.* 2018]. That fact brought us to a deeper study of this issue.

To determine the optimal parameters of the power load for fighters training in the anaerobic or aerobic mode of power supply, the surveyed athletes exchanged models of trainings developed for each group. Due to our supposition, that should determine the influence degree on the functional capabilities of athletes' bodies.

The results of controlling the characteristics of changes in the development of the athletes maximum strength in both research groups after changing the models of training sessions for the next 3 months also showed a positive trend, but with a significantly lower progression (Figure 1). Thus, in group A the studied indicators showed an increase of only 7.1%, while in the representatives of B group, the parameters of maximum strength were increased by 13.9% when performing the control exercise.

At the same time, one of the most important but not thoroughly studied problematic issues in the physical training of MMA fighters is the choice of optimal

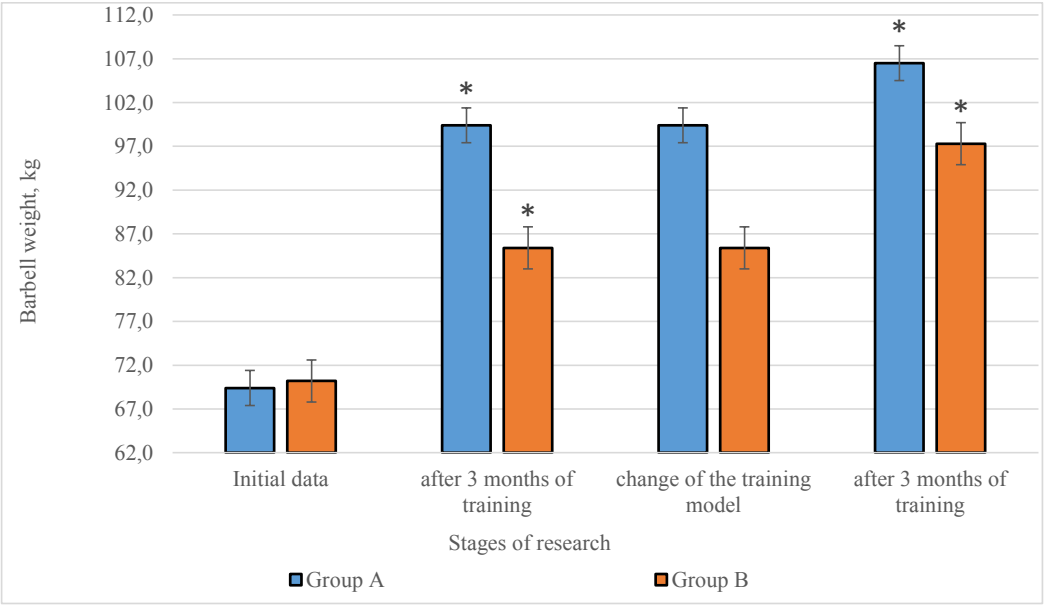

Fig. 1. Dynamics of indicators of developing maximum strength of both groups participants during the bench press exercise for 6 months of research, n = 30

Note: * – p <0.05, in comparison with the previous control results.

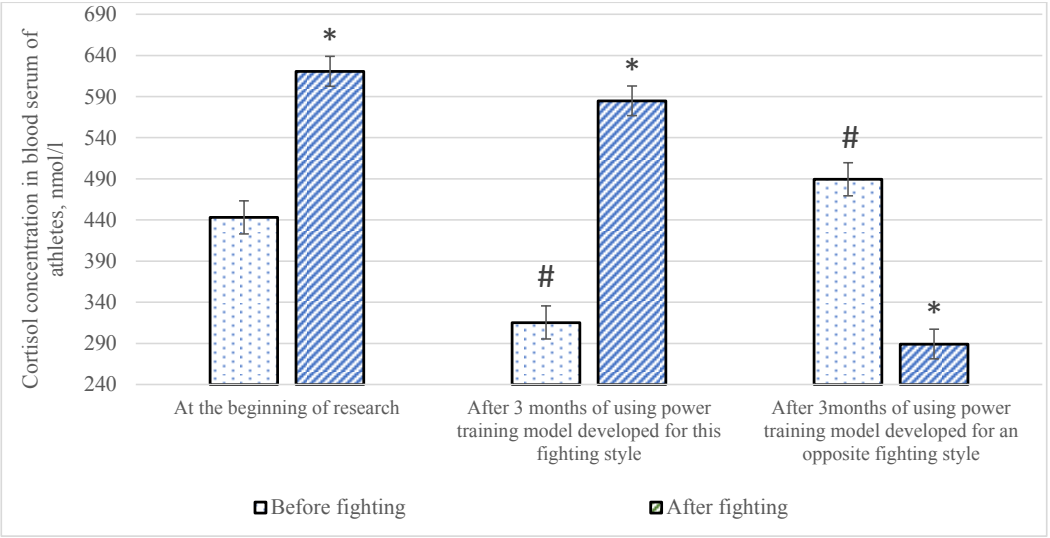

Fig. 2. Change in cortisol concentration of group A athletes' blood serum during all stages of the study, n = 15

Note: * – p <0.05, in comparison with the results before the fight;

– p <0,05, in comparison with previous control indicators of the basal level of this hormone.

power-load regimes (occupation models) in the process of training to maximize the functional potential of the body during the fights. In this regard, we checked the loads adequacy to the functional capabilities of athletes by using biochemical markers. This helped us to determine the degree of effectiveness of the influence of the training session experimental models developed by us on the level of athletes' adaptive capabilities in the process of competitive activity.

Fig. 2 presents the results of studying the peculiarities of the change in the cortisol concentration in the blood serum of group A athletes, who use predominantly strike fighting technique in the course of the competition, in the conditions of a long application of two completely opposite models in power training.

The analysis of the results revealed at the beginning of the research indicated that the biochemical changes in the concentration of this hormone in the blood of the representatives of the study group fixed after the fight show an increase of 40.1% compared to the resting state, normal adaptive reactions in their bodies in response to a stressful situation. The established fact shows that the power training loads used by these athletes in the research, were absolutely adequate to their functional capabilities.

Figure 3 shows the results of changes in the cortisol concentration in the blood serum of group B athletes in

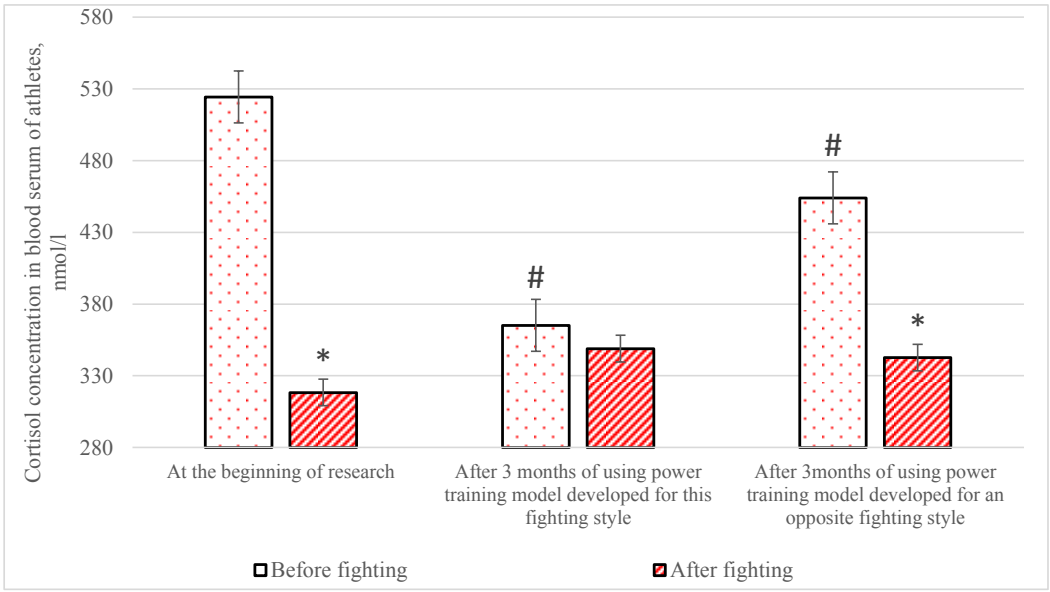

Fig. 3. Change in the cortisol concentration in the blood serum of group B athletes during all stages of the study, n = 15
Note: * – p <0.05, in comparison with the results before the fighting;
– p <0,05, in comparison with previous control indicators of the basal level of this hormone.

Table 1. The values of athletes' performance in the dynamics of observation

Group	Indices					
	Max strength, kg			Changes in cortisol concentration in blood (nmol/l), Me (25%;75%)		
	Initial data	After 3 months	After 6 months	Initial difference	After 3 months	After 6 months
А (n=15)	68,2±3,7	99,2±9,3* Z=3,4 P<0,00066	105,8±7,4** Z=3,29 P<0,00098	184,8 (100; 263)	275 (200;311)	250 (144;276)
Б (n=15)	68,1±2,3	83,8±4,9* Z=3,4 P<0,00065	95,0±6,4** Z=3,4 P<0,00066	197 (109;269)	12* (2;43) Z=3,4 P<0,00065	98** (69; 166) Z=2,7 P<0,005

* - differences in the initial values of the indicator and values after 3 months are reliable;
** - differences in the values of the indicator at 3 and 6 months are reliable.

rest and after fighting during all stages of the study while using different models of power training.

The results of the studies, fixed before the long-term use of experimental power-load models, showed a 39.3% decrease in the controlled biochemical index after the training fighting versus the rest state. This circumstance indicates a huge energy deficit in fight conducting conditions with a high intensity and with the predominant use of wrestling techniques. The latter is performed primarily in the anaerobic energy supply, which facilitates the activation of gluconeogenesis processes. Based on the analysis of the obtained results, it can be concluded that the training loads that this group representatives used in the preparation process prior the research are not sufficiently adequate to the functional body capabilities of the surveyed athletes.

However, the analysis of the results fixed after 3 months personally developed power training by group B athletes, taking into account the priority use of wrestling techniques, indicated an increase in the level of body adaptation to glycolytic work, as well as to increase of their functionality in these conditions of muscle activities. Thus, in the course of the studies, the initial level of cortisol in the blood of fighters was reduced by 30.3%. At the same time, the parameters of this biochemical index practically did not change after the fighting in comparison with the state of rest, which indicates an increase in the body resistance level to the stress effect of the proposed loads.

The dispersion analysis was carried out to confirm the effect of the type of power training programmes offered by us on the functional potential of the athletes in the study groups. In accordance with the Levene test, the variances of the analysed indicators are not the same. In addition, the indicators are not distributed according to the normal law, which prevents us from using the parametric ANOVA for repeated measurements. That is why we used the Friedman test, which is a non-parametric statistical test similar to the parametric repeated measures ANOVA. It is used to analyse repeated measurements associated with the same individual.

Differences in the parameters of the maximum muscle strength and changes in the cortisol concentration in blood (modulus of the difference between the final and initial values for a given load) were assessed in the dynamics of observations. We revealed significant changes in the indices of maximal muscle strength ($\chi 2 = 19.54$, $p < 0.00006$) and changes in cortisol concentration ($\chi 2 = 6.2$, $p < 0.004$) in three stages of observation in group A representatives. Athletes of group B also showed significant changes in the indices of the maximum muscular strength ($\chi 2 = 20.0$, $p < 0.00005$) and changes in the cortisol concentration of ($\chi 2 = 12.8$, $p < 0.0016$). To clarify the obtained results we performed pair comparisons of the indices using the Wilcoxon test at different observation times (Table 1). Due to the fact that the cortisol concentration in blood of athletes and the rate of its change have a significant individual variability, it was necessary to calculate Me and quartiles (25% and 75%).

Discussion

One of the priority factors, together with high technical and tactical training of athletes, allowing to achieve a short-term and bright victory in combat in mixed martial arts is the level of development of the body power capabilities. Correction of the development process of body power capabilities in athletes with different styles of fighting, based on the analysis of our experimental research results, will allow us to optimise the training system in both training and competitive activities [Loturco *et al.* 2018].

Were observed, controlled power indicators of the group A athletes show an increase of 43.2% in comparison with the initial data. Similar positive dynamics, but with less pronounced indices, was revealed among representatives of the group B. Thus, their strengths in the "bench press" exercise increased by 21.6% for a given period of time, which is also an excellent result considering the fact that their physical training programme was based on work in the glycolytic mode of aerobic power supply and directed mainly to the development of power endurance, which is so necessary for fighters using predominantly wrestling style of fighting.

The obtained results indicated that the models of power training, developed on the basis of work precisely in the anaerobic mode of energy supply in the process of muscular activity, most effectively contributed to the development of power capabilities to the body of athletes who use the strike technique of fight performed in MMA. At the same time, universally recognised ("standard") for the fitness programme of trainings are the most optimal for increasing the parameters of maximum strength of the fighters, who specialise mainly in wrestling style.

Similar biochemical changes of the monitored indicator were revealed after 3 months of using developed power training model during the training activity. Thus, the studied hormone demonstrated an increase in blood concentration by 85.4% after the fight, but does not exceed the limits of the physiological norm. At the same time, it was found out that the initial level of cortisol concentration in the blood of athletes showed a decrease of 28.8% in comparison with the results fixed at the beginning of the study. This circumstance indicates existing adaptive changes in group A fighters' bodies.

The obtained results reflecting the character in the parameters change of the maximum force (1PM) in the athletes of the surveyed groups, depending on loads intensity and the features of the training sessions models, are confirmed by the data of experimental studies conducted in power sports [Chernozub 2015; Schoenfeld *et al.* 2016]. The use of high-intensity loads in the anaerobic regime of energy supply during the preparation process, emphasising precisely the slow fulfilment of eccentric phases of motion, contributes to pronounced (more than 40%) changes in the power capacity in comparison with aerobic loads with a large amount of work performed [Henselmans *et al.* 2014; Calatayud *et al.* 2016].

The necessity to use complex informative biochemical control of the adequacy of training loads to the body functional capabilities is caused by a number of rather contradictory factors, when, due to increasing morphofunctional indices, in the process of competitive activity we get a negative result caused by disadaptation mechanisms [James *et al.* 2016; Latyshev *et al.* 2017].

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The features of the change in the concentration of steroid hormone in the blood serum of athletes with different fighting styles in the conditions of acute physical exertion and during a long period of applying various models of strength training, are confirmed by the results of research in power and cyclic sports in the conditions of applying such regimes of power loads [Slimani *et al.* 2017; Philippou *et al.* 2017].

In turn, the results of biochemical blood tests of group A athletes demonstrated compensatory body reactions in response to stress during a control testing (combat). The latter took place after 3 months of using the power training programme for wrestling style fighters. Thus, the initial level of the studied hormone in the blood of participants demonstrated an increase of 55.2%, which indicated a decrease in the level of body

adaptation to this training process. At the same time, the concentration of cortisol in the blood serum of the examinees was reduced by 40.9% after the fighting, which indicated a high energy expenditure in the conditions of this muscular activity. The hormone decrease also indicated inadequate loads to the functional capabilities of their bodies.

However, the analysis of the results fixed after 3 months personally developed power training by group B athletes, taking into account the priority use of wrestling techniques, indicated an increase in the level of body adaptation to glycolytic work, as well as to increase of their functionality in these conditions of muscle activities. Thus, in the course of the studies, the initial level of cortisol in the blood of fighters was reduced by 30.3%. At the same time, the parameters of this biochemical index practically did not change after the fighting in comparison with the state of rest, which indicates an increase in the body resistance level to the stress effect of the proposed loads.

However, despite the clear body adaptation changes in the group B athletes described above, the subsequent long-term use of power programmes developed for fighters with predominance of strike fighting style causes completely opposite changes. Thus, the initial level of the studied hormone in the members of this research group showed an increase of 24.4%, which indicates a decrease in the level of body adaptation to training loads characteristic of the proposed experimental training model. At the same time, the cortisol concentration in the blood serum, fixed after the fighting, was reduced by 24.5% ($p < 0.05$), which indicates the manifestation of compensatory reactions and the activation of gluconeogenesis processes, possibly caused by a low level of energy supply for motor activity or by high energy costs.

Thus, using models of intensive training sessions with a small amount of work contributes to the processes of long-term adaptation (increase in the cortisol concentration in response to an acute load), which is indicated not only by our results, but also by researchers in other sports [Wahl *et al.* 2013; Chernozub 2015]. At the same time, a decrease in the level of this hormone in the blood in response to an aerobic load testifies to an excessive amount of training work and activation of compensatory body reactions of fighters [Chernozub 2015; Cadegiani *et al.* 2017; Skurvydas *et al.* 2017; Wochynski *et al.* 2017]. Continuous use of such training load models will lead to processes of disadaptation and, of course, to the decrease of effectiveness.

Conclusion

The analysis of the results obtained during the series of experimental studies indicates the need to use models of MMA fighters' power training, developed taking into account the style of conducting the fight. Although the body's power capabilities control testing results in the athletes from both groups, showed that the level of maximum strength development was significantly increased, regardless of the proposed training programme, we also observed different adaptation-compensatory reactions at different stages of the experiment.

The results reflecting the changes in cortisol concentrations in the blood serum of the examined athletes throughout the entire period of the study, in different conditions of motor activity, indicate that the optimal power loads for fighters using the combat style of fighting will be the use of a high-intensity regime when working with an alactate or lactate system power supply. In turn, the most effective loads of force, for the maximum realisation of the functional potential of athletes, prioritising the wrestling style during the fight, is the use of low-intensity regimes with a large amount of work in the glycolytic power supply system.

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Opracowanie treningu siłowego w mieszanych sztukach walki w zależności od stylu walki z przewagą uderzania lub chwytania/zapasów

Słowa kluczowe: mieszane sztuki walki (MMA), modelowanie treningu siłowego, sposób walki, reakcje adaptacyjno-kompensacyjne.

Abstrakt

Problem. Celem pracy było opracowanie modeli treningu siłowego dla sportowców mieszanych sztuk walki, w zależności od wykorzystywania w walce elementów uderzania lub chwytania, a także określenie wpływu proponowanych obciążeń treningowych na zwiększenie zdolności funkcjonalnej zawodników.
Metody. Autorzy przyjrzeli się dokładnie 30 sportowcom w wieku 20-22 lat, którzy uczestniczyli w walkach MMA w ciągu ostatnich 2 lat. Stwierdzono, iż połowa zawodników używała stylu uderzeniowego w trakcie walki, a reszta specjalizowała się w sposobie zapaśniczym. Aby ocenić skuteczność opracowanych modeli, wykorzystano metodę testowania kontrolnego poziomu rozwoju siły. Przy pomocy biochemicznej kontroli stężenia kortyzolu w surowicy krwi zawodników, określono

przejawy adaptacyjno-kompensacyjnych reakcji organizmu na różne obciążenia energetyczne.
Wyniki. Ustalono, że najbardziej optymalnym obciążeniem dla zawodników preferujących styl walki z przewagą uderzeń było stosowanie systemu o dużej intensywności podczas pracy z mleczanowym lub bezmleczanowym układem dostarczania energii. Z kolei najbardziej efektywnymi obciążeniami siłowymi, dla maksymalnej realizacji potencjału funkcjonalnego sportowców preferujących styl zapaśniczy w czasie walki, było zastosowanie systemów o niskiej intensywności z dużym nakładem pracy w systemie zasilania glikolitycznego.
Wnioski. Analiza wyników uzyskanych w trakcie eksperymentu wykazała potrzebę stosowania schematów treningów opracowanych w procesie treningu siłowego zawodników MMA, biorąc pod uwagę ich styl walki.