

The effectiveness of using power fitness training loads to increase adaptive reserves of female athletes in hand-to-hand combat

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Abstract

Background and Study Aim

One of the main aspects of improving the special training of athletes in hand-to-hand combat is increasing functional reserves in conditions of power loads. Study Purpose - to study the peculiarities of adaptive body changes and the level of special training in female athletes of hand-to-hand combat using power fitness programs with different structure, parameters, and means.

Material and Methods

We examined 36 female athletes (18-20 years old) who had been engaged in hand-to-hand combat for the last 4 years. We divided these women into two groups, 18 people in each group. Groups used completely different power fitness training programs. We used methods of testing special training (the number of accurate kicks on the mannequin for 30 s) and laboratory monitoring of blood biochemical parameters (cortisol and LDH) before and after training load during 3 months. Group A used the standard power fitness training program for women of this age (exercises on simulators). Group B used well-known exercises with their own body weight with a complete change of kinematic and dynamic characteristics of the technique during 3 months of training.

Results

The obtained results showed that indicators of special training positively changed by 10.4% ($p < 0.05$) in group B athletes. At the same time, the studied indicator increased by 2.2% compared to initial level in group A athletes. At the end of the study, we observed an increase in cortisol level in the blood serum of group B athletes in response to physical stimuli. This was almost 10 times lower than the results recorded in group A. The results of monitoring LDH activity in the blood serum showed that its level increased by 19.5% ($p < 0.05$) during the entire study period only in group B athletes. The controlled indicator remained almost unchanged in group A. The dynamics of the studied steroid hormone and enzyme in the blood serum in group B indicated an increase in the level of organism resistance to training loads under specified conditions of muscular activity and their pronounced adaptive changes.

Conclusions

Determining the most effective power fitness training program for special training of female athletes in hand-to-hand combat, will help to increase their adaptive body reserves and their level of fitness. For this using different in structure and parameters training load.

Keywords: hand-to-hand combat, adaptive changes, power fitness, female athletes, training programs.

Introduction

Modern aspects of improving the mechanisms of training in hand-to-hand combat and other martial arts aimed at achieving maximum results in the shortest possible time. Such an approach demand from scientists and coaches to find effective ways to optimize the training system [1, 2, 3, 4].

One of the important factors of improving the training process is a reasonable choice of specialized

training programs aimed at increasing the functional reserves of athletes [5, 6, 7, 8], or certain physical qualities [6, 9, 10, 11, 12].

In recent years, a number of martial arts experts [13, 14, 15] have studied the mechanisms of solving this problem and the possibility of implementing the results in practice. In turn, most of these scientific works [16, 17] presented the study of ways to improve training and competitive activities by correcting the means, methods, load parameters, mainly in highly skilled hand-to-hand athletes.

However, modern specialists in this field have

not paid enough attention to solving the problem of finding effective and safe ways to increase the functional capabilities of athletes. This applies the stage of specialized basic training of women in hand-to-hand combat.

The relevant areas of research in this field relate to using power training, specialized methods, tools and programs of power sports in the process of special training in martial arts. Also studying their impact on performance in competitive activities [3, 18, 19].

There are several controversial issues concerning the process of power training of athletes in hand-to-hand combat and other martial arts:

- indicators of volume and intensity of training loads;
- number of sets and approaches;
- the effectiveness of exercises (on simulator, with dumbbells, with own weight);
- increasing body reserves.

This is especially true for female athletes, as the level of resistance to stress stimuli in the anaerobic mechanism of energy supply is quite low and there is a great risk of failing the adaptation process [9].

In this context, it is recommended to pay attention to the following features of strength fitness for women:

- Resistance training under dynamic conditions can trigger delayed adaptation to training conditions [20];
- The increase in maximum oxygen consumption results in an increase in aerobic metabolism and a decrease in the lactic acid function, which prevents the first symptoms of fatigue and forms coordination reserves as the foundation of neuromuscular performance [21].
- An outstanding enhancement of muscle strength after late puberty, which is unlikely to occur in ordinary women, would be an important requirement to become the world's top female wrestler [22].

well-developed aerobic capacity is the basis for maintaining a high level of performance [23].

- Such approaches contribute to the improvement of the adaptive capabilities of female athletes during power fitness training loads.

Purpose of the Study is to study the peculiarities of adaptive body changes and the level of special training in female athletes of hand-to-hand combat using power fitness programs with different structure, parameters, and means.

Materials and Methods

Participants.

We examined 36 female athletes (18-20 years old) who had been engaged in hand-to-hand combat for the last 4 years. To achieve the purpose of the

study we divided these women into two groups of 18 people in each, who used completely different power fitness training programs.

The research was approved by the Ethical Committee for Biomedical Research of the Lesya Ukrainka Volyn National University in accordance with the ethical standards of the Helsinki Declaration. The research participants gave written consent to the study in accordance with the recommendations of the Biomedical Research Ethics Committees [24]. We used diagnostic equipment of the medical center of the university for medical examination, assessment of functional parameters, biochemical control of blood serum in athletes of both groups during the study.

Research Design.

Group A used the standard power fitness training program for women of this age (exercises on simulators) (table 1). Group B used well-known exercises with their own body weight with a complete change of kinematic and dynamic characteristics of the technique during 3 months of training (table 1).

Table 1 presents the most commonly used group training programs for women of this age in power fitness [9]. Thus, the athletes of group B used the training program B during 3 months of research. This program consisted of well-known exercises with own body weight, but with some peculiarities concerning kinematic (body position in space), dynamic (duration of muscle tension and recovery in a set), and rhythmic (range of motion, duration of concentric and eccentric phases) characteristics of the technique. Group A representatives used the training program A, which is standard in power fitness. The main set of tools of this program consists of exercises on simulators in compliance with standard training load parameters [11].

To assess the adaptive body changes in both group athletes we used methods of testing special training (the number of accurate kicks on the mannequin for 30 s) and laboratory control of blood biochemical parameters (cortisol and LDH) before and after training load during 3 months. Venous blood sampling was performed by a paramedic before and after training at the beginning and end of 3 months of studies in compliance with all standards [25]. The activity of lactate dehydrogenase (LDH) in the blood serum of women was determined by kinetic method on the equipment of the company «High Technology Inc» (USA) with a set of reagents PRESTIGE 24i LQ LDH (Poland). The concentration of cortisol in the blood serum was determined by enzyme-linked immunosorbent assay, using a set of steroids ELISA on the equipment of the company «Alcor Bio».

Statistical Analysis.

Statistical analysis of the study results was performed using the software package IBM * SPSS

Table 1. Power fitness training programs used by athletes during the study

Structural components	Training program A	Training program B
A set of means	Athletes use mainly exercises on simulators; exercise technique meets the generally accepted requirements in power fitness; no more than 2 muscle groups are involved during one exercise.	Athletes use well-known exercises with own body weight with full change of kinematic, dynamic and rhythmic characteristics of the technique; about 5-6 additional muscle groups are involved during one exercise
Training load parameters	The training lasts 90 minutes; the working weight of the load is 35-50% of 1RM; the duration of the set is about 90 seconds; rest between sets ranges within 60 s; exercises are performed with full amplitude; 3-4 sets per exercise; the number of repetitions in a set is 28-30; the total number of exercises during one training is 7-8	The training lasts 45 minutes; the set lasts until the working muscles are completely tired (performance technique deteriorates); duration of rest between sets is 30 s; the concentric phase duration is 3 s and the eccentric - 6 s; partial amplitude (85% of max) is used during exercises; intermuscular coordination is additionally activated in the concentric phase; the number of exercises in one training is not more than 6; the number of sets per exercise is 4-5.
Mechanism of correction	In most cases, it is preferable to change the projectile working mass (increase by 10-15%) and the sequence and variability of using training exercises. The speed of performing exercise is changed very rarely.	The duration of the eccentric phase increases (9-11 s) to enlarge muscle tension; the technique of performing the exercise changes due to the amplitude and position of the body in space, and changes in the level of intermuscular coordination; there is a decrease in the duration of rest intervals between sets. The level of exercise complexity and their variability is constantly changing.

Note: 1RM - one-repetition maximum.

* Statistics 23 (StatSoftInc., USA). Descriptive statistics methods were used to calculate the arithmetic mean and the error of the mean. The non-parametric Wilcoxon test was used to assess the reliability of paired differences, and Friedman's ANOVA was used to analyze repeated measurements [26].

Results

Table 2 presents the results special training indicators (the number of accurate kicks on the mannequin for 30 s) in female athletes of both groups during 3 months of using the proposed power fitness training programs.

The results of special training (the number of accurate kicks on the mannequin for 30 s) increased by 10.4% ($p < 0.05$) in group B female athletes, who used well-known exercises in fitness with their own body weight with a complete change of kinematic and dynamic characteristics of the technique during 3 months of training. At the same time, group A athletes showed positive dynamics in special training by 2.2% although they used the standard power fitness training program (exercises on simulators). The studied indicator was compared to initial data. The obtained results indicate an increase in adaptation reserves and the level of strength endurance in female athletes of group B. These adaptation processes occur due to the increase of intramuscular and intermuscular coordination.

The results of laboratory control of cortisol concentration and LDH activity in the blood serum of both group athletes allowed to determine the

nature of adaptive-compensatory responses to stress stimuli in given conditions of muscular activity during all stages of the study (Fig. 1, Fig. 2).

The changes in the activity of LDH in the blood serum of group A athletes in response to physical stimuli showed almost identical growth of 8.2-8.4% ($p < 0.05$) at all stages of the study. This fact indicates the lack of increased body functionality in these conditions of muscular activity and indicates the need to adjust the training program. However, we observed an increase in basal level of this enzyme by 12.4% ($p < 0.05$) in group B athletes due to the lack of significant increase in LDH activity in response to training load at the end of the study. The obtained changes indicated the growing level of resistance in group B participants to this stress stimulus and their positive adaptive body changes.

Figure 2 graphically shows the average group values of cortisol in the blood serum of both group participants at rest and after training load using the proposed power fitness training programs for 3 months.

The results obtained at the beginning of the study showed that the concentration of cortisol in the blood serum of group A participants increased after training by 57.9% ($p < 0.05$) compared with rest. At the same time, the concentration of this steroid hormone in the blood serum of group B athletes increased by 80.4% ($p < 0.05$). The difference can be explained by the fact that using a set of exercises with your own body weight requires the inclusion of many additional muscle groups simultaneously, which demands significant energy expenditure to

Table 2. The number of accurate kicks on the mannequin for 30 s performed by both group athletes during the study, n = 36

Control exercises	Group	Observation period, months			χ^2 , p df=2
		Initial data	After 45 days of training	After 90 days of training	
Front kick	A	10.68±0.22	10.80±0.23 Z=-1.1; p>0.05	10.83±0.19 Z=-0.3; p>0.05	$\chi^2=2.2$ p>0.05
	B	10.57±0.18	10.98±0.19* Z=-2.4; p<0.05	11.81±0.26* Z=-3.4; p<0.001	$\chi^2=22.6$ p<0.000
Side kick	A	13.95±0.21	14.18±0.19 Z=-1.4; p>0.05	14.21±0.18 Z=-0.4; p>0.05	$\chi^2=4.9$ p>0.05
	B	13.83±0.17	14.29±0.19* Z=-2.2; p<0.05	14.85±0.22* Z=-2.8; p<0.005	$\chi^2=15.2$ p<0.001
Reverse side kick	A	12.30±0.17	12.56±0.16 Z=-1.7; p>0.05	12.71±0.15 Z=-1.5; p>0.05	$\chi^2=9.1$ p<0.009
	B	12.38±0.14	12.94±0.17* Z=-2.8; p<0.005	13.84±0.12* Z=-3.2; p<0.001	$\chi^2=27.4$ p<0.000
Roundhouse kick	A	13.54±0.17	13.82±0.13 Z=-1.7; p>0.05	13.88±0.11 Z=-0.7; p>0.05	$\chi^2=6.1$ p<0.04
	B	13.61±0.16	13.95±0.14* Z=-2.3; p<0.05	15.15±0.16* Z=-3.9; p<0.000	$\chi^2=31.7$ p<0.000

Note: * the difference in comparison with previous results is significant according to the Wilcoxon test (p < 0,05); df - the number of degrees of freedom; p - level of significance.

overcome the external stimulus, which increases the level of stress [9].

The results recorded after 3 months of research showed that there was an increase in cortisol level in the blood serum of group A athletes by 54.1% (p < 0.05) in response to stress stimuli. However, an increase in the concentration of this hormone in the blood serum of group B athletes was only by 5.8% compared to rest. This fact proves that increasing level of training makes the response of the endocrine system to this type of stress decrease and increases the body resistance to this kind of training [27, 28].

Discussion

The problem of finding effective and safe ways to increase the adaptive reserves of athletes in hand-to-hand combat for their maximum implementation of tactical and technical skills in competitive activities, constantly leads to controversial discussions among specialists [2, 16].

For example, Vasilievna et al. [29] argue that strength exercises based on mixed muscle work have a targeted effect on the muscles of the arms, legs, and abs of hand-to-hand combat athletes. Serebryak et al. [30] conducted a study involving 58 hand-to-hand combat athletes. The authors have developed and approved the most effective technical and tactical schemes for building a duel with opponents. Our training program is supplemented by the

results of the analysis of biochemical parameters. In this context, our approach requires the involvement of other specialists in the training of hand-to-hand combat athletes.

The main concern is the need to optimize loads in the process of special power training in hand-to-hand combat and especially among women, which will increase the level of functional body capabilities in the shortest possible time. One of the main aspects of improving the control system of training loads, which scientists have been paying attention to in recent years, is the systematic use of blood biochemical indicators to assess adaptation processes [3, 13, 17, 31].

Our research determined that using only power fitness training program, consisting of exercises with their own body weight and a complete change of standard kinematic and dynamic characteristics of equipment, helped hand-to-hand combat female athletes to improve special training results. The obtained data confirmed the results of research in power fitness using the same training loads for women of this age group [9, 32, 33].

In this context, study by Bujak et al. is a good addition. [34]. The authors argue that hand-to-hand combat requires different bioenergetic potential and anthropometric profile of athletes.

The changes in cortisol concentration and LDH activity in the blood serum of hand-to-hand

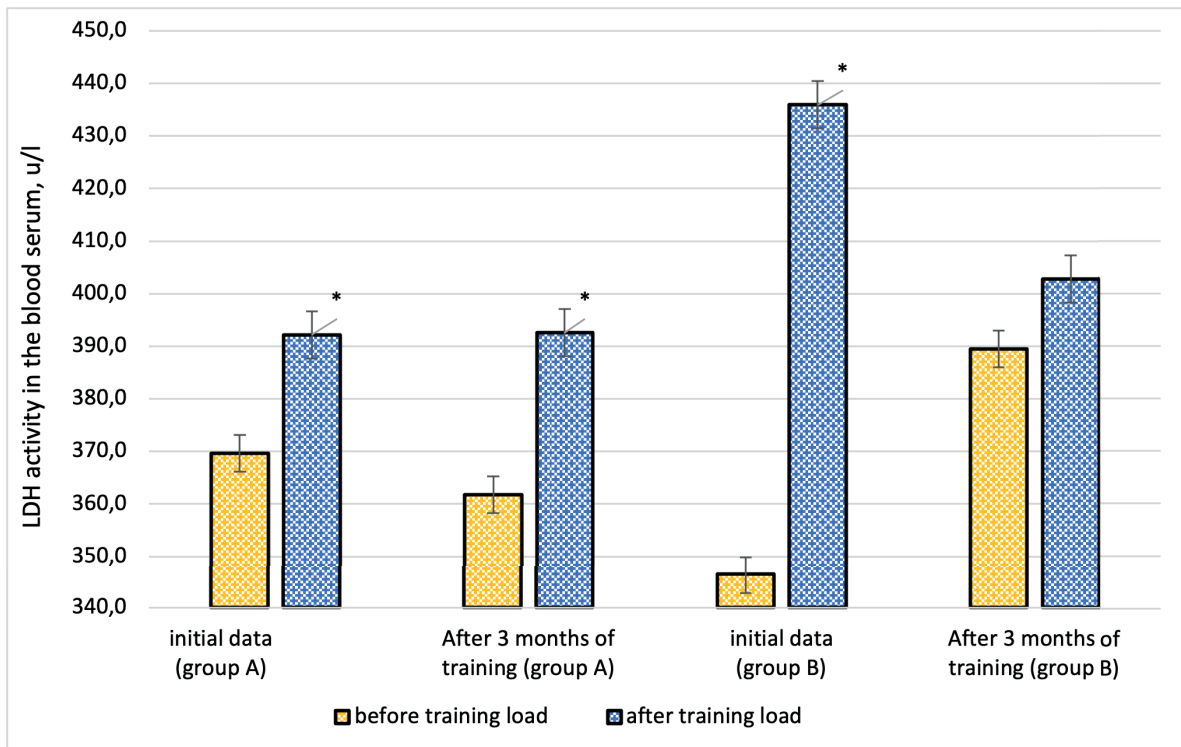


Fig. 1. Change in LDH activity in the blood serum of group A and B female athletes during the research, n = 36. Note: * - p < 0.05, compared to the indicators before training load.

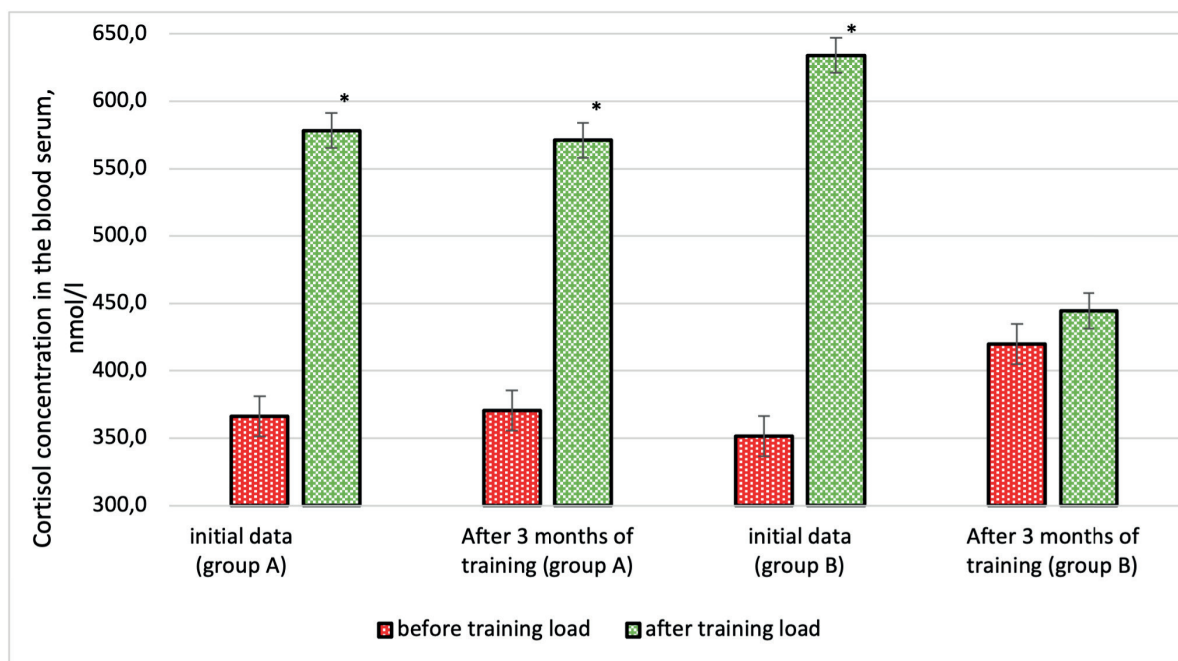


Fig. 2. Change in the concentration of cortisol in the blood serum of group A and B female athletes during the research, n = 36. Note: * - p < 0.05, compared to the indicators before training load.

combat female athlete using power fitness training programs do not coincide with the results presented in the available scientific literature [27, 28, 35]. At the same time, we have not found data on using biochemical parameters of blood serum (cortisol and LDH) in hand-to-hand combat athletes to assess changes in the adaptive body reserves in terms of

muscular activity of power orientation.

Conclusion

The special training results increased by 10.4% (p < 0.05) on average in female athletes of hand-to-hand combat, who used power training programs, consisting of exercises with their own body weight

with a complete change of kinematic and dynamic characteristics during 3 months of research. At the same time, the studied indicator increased by only 2.2% compared to initial level in female athletes who used the standard power fitness training program for women of this age (exercises on simulators).

The increase in cortisol concentration in the blood serum of group B athletes, recorded at the end of the study in response to physical stimuli, was almost 10 times lower compared to the results of group A athletes. There was an increase in LDH activity in the blood serum by 19.5% ($p < 0.05$), especially its initial level, in group B representatives during the entire study period.

Determining the most effective power fitness training program for special training of female athletes in hand-to-hand combat will help to increase their adaptive body reserves and their level of fitness in the shortest possible time by using different in structure and parameters training load.

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Conflict of interest

No potential conflict of interest that is of any relevance to this study was reported by the authors.

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