The effect of a multidirectional functional load by means of OFP on the indicators of systemic hemodynamics and vegetative support of qualified boxers

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Abstract

Objective of the study was to influence of multidirectional functional load by means of general physical training on the indicators of systemic hemodynamics and autonomic support of qualified boxers.

Methods and structure of the study. Two equal groups of 1st category boxers from 18 to 20 years old, 15 people in each group, were formed: experimental group (EG) and control group (CG). All athletes were represented in the weight category up to 71 kg.

Results and conclusions. Multidirectional means of functional training for indicators of systemic hemodynamics and autonomic support of the body of qualified boxers have been identified. During testing, the fact was recorded that the use of general physical training tools, which largely involve the muscles of the lower extremities in the activity, contributes to the adequate development of optimal functional training in boxing, which is qualitatively reflected in the indicators of systemic hemodynamics and autonomic support of the athletes body in response to the work performed.

Keywords: *indicators of systemic hemodynamics and autonomic support of the body, multidirectional functional training, general physical training tools, ultrasound examination of the heart.*

Introduction. Analysis of a number of scientific studies allows us to make the assumption that the striking movements of boxers who use different tactics in a fight require multidirectional functional and motor training to increase their functional capabilities [8]. The process of improving the speed-power characteristics of strikes is built taking into account the intermuscular interaction used by boxers in different tactical manners of fighting [5]. The authors testify that boxers who use a playful manner in a fight begin the striking movement by powerfully involving the muscles of the lower extremities in the activity. At the final phase of the movement, the muscles of the torso and shoulder are involved in the work, and the blow itself develops from the leg muscles by transferring inertial activity to the following kinematic chains. Researchers note that impacts of this type of intermuscular interaction are usually called ballistic [8]. Boxers of a different tactical style of fighting - knockouts - prefer to achieve victory by delivering an accented blow, focusing on the final phase of the striking movement with more pronounced activity of the muscles of the upper extremities [5, 8].

Based on the above, a number of researchers make the assumption that the use of various fighting styles requires adequate means of developing functional capabilities when using general physical training in the training process of qualified boxers [5, 6, 8].

Objective of the study was to analysis of identifying multidirectional functional load by means of general physical training on indicators of systemic hemodynamics and autonomic support of qualified boxers.

Methods and structure of the study. Two equal groups were formed of 1st category boxers from 18 to 20 years old, 15 people in each group: experimental group (EG) and control group (CG). All athletes were represented in the weight category up to 71 kg.

Qualified athletes were given the task of improving functional training, based on the tactical features of fighting. Boxers-players used general physical training tools aimed at developing the muscles of the lower extremities (EG). Athletes who use a strong blow to achieve victory in a fight (knockout boxers) used exercises that largely developed the muscles of the upper limb girdle (CG).

During the study, testing was carried out to assess the functions of systemic hemodynamics and autonomic support of the body of athletes for multidirectional motor activity. Athletes from the EG performed squats at maximum speed for 30 s. With a similar time period, athletes from the CG performed push-ups from the floor while lying down, at a maximum pace.

The following analysis methods were used: echocardiography (ultrasound) of the heart [4]. During the testing, a comprehensive transthoracic echocardiography of the heart was performed in two-dimensional (2D) B-mode. Systemic hemodynamic parameters were obtained using the En Visor C HD Philips ultrasound system. Scientific work was carried out in parasternal and apical standard positions. During testing, indicators obtained at rest and in the first minute of recovery after physical activity were recorded: heart rate (HR, beats/min), minute volume of blood flow (MVR, l/min), cardiac index (CI, l/min/ m2), left ventricular stroke volume (LV SV, ml), blood pressure indicators (systolic - BP and diastolic - BPd, mm Hg) and central venous pressure (CVP, mm Hg) [2, 4]. Pulse pressure (PAP, mm Hg) is calculated as the difference between systolic and diastolic blood pressure: PAP=BPs–APd. Mean arterial hemodynamic pressure (MAP, mmHg) was calculated using the formula: MAP=ADd+ADp/3 [3, 7]. We calculated the values of total peripheral vascular resistance (TPVR, dyn/s/cm-5): TPVR=80 (BPmean-CVP)/IVR [1]. The indexing of the BPSS indicator was carried out by calculating using the formula (IPSS, dyn/s/cm-5/m2): IPSS=(BPsr–CVD)/SI [1]. Echocardiography results were assessed according to the recommendations of the American and European Associations of Echocardiography.

To determine the values of vegetative support due to multidirectional motor activity, we used the double product index (Robinson index), determined by the formula: DP=HR BPs/100, (arbitrary units) [6]. The calculation of the myocardial tension index (MIS, arbitrary units) was defined as: MSI=BPs HR/1000 [5]. During the study, the circulatory efficiency coefficient (CEC, arbitrary units) was calculated: CEC=BPp HR [6, 7]. The obtained data were processed using the statistical analysis program Statistica 10.0. To assess significance, the nonparametric Mann–Whitney test was used.

Results of the study and discussion. When analyzing the results of systemic hemodynamics on the nature of intermuscular interaction, it was recorded that the values of CVP, LV SV, ABP and ABP were not marked by statistical significance of differences at all stages of testing ($p>0,05$; Table 1). Comparing the data of other indicators of systemic hemodynamics, we noted the following values: the values of OPSS observed after exercise in the EG were 20,7% lower compared to the results of the CG and decreased by 31,5% when compared with the data recorded at rest ($p<0,05$). In the CG, similar values became lower by 29,5% ($p<0,05$). IPSS data recorded after exercise in the EG were not noted by us as statistically significant differences relative to the

Table 1. Indicators of systemic hemodynamics in qualified athletes with multidirectional load by means of general physical training, X±m

Boxers of the 1st category				
Indicators	Control group		Experimental group	
	Peace	Load	Peace	Load
OPSS (din/s/cm-5)	1507,9±102,7	1063,5±69,5#	1300,5±98,4	843,8±57,6*#
IPSS (din/s/cm-5/m^2)	2440,4±131,2	1981,4±99,5	2183,4±109,8	1609,1±89,6#
BPs (mm Hg)	118,6±4,3	137±7,2	119,2±4,6	155,8±10,7#
ADP (mm Hg)	40,2±2,9	55,4±6,2#	39,8±3,2	73,8±6,4*#
SI (l/min/m^2)	2,9±0,1	4±0,3#	3,3±0,2	5,1±0,5*#
MOK (l/min)	4,7±0,4	7,4±0,5#	5,4±0,6	9,8±1,1*#
Heart rate (bpm)	64±4,6	92,6±5,3#	70,8±5,1	122,6±6,7*#

** – reliability of differences between the data from the EG and the CG, p<0,05; # – reliability of the load data relative to the resting level, p<0,05.*

control results (p>0,05); they became 26,3% lower relative to the values observed at rest (p<0,05). In the CG, similar results became lower, but we did not note that the differences were significantly significant (p>0,05). Based on the obtained values, it was noted that more significant muscle involvement during general physical fitness exercises is characterized by a low level of the indicator, determined by more significant post-load effects in the EG, which is most important for ensuring delayed recovery processes in the body of athletes.

The blood pressure values in the EG, recorded after testing, were not marked by statistical significance of differences relative to the control level (p>0,05); they became 30,7% higher relative to the results observed at rest (p<0,05). In the CG, similar results became higher, but were not marked by significant differences (p>0,05). The ADP values noted after the load in the EG were 33,2% higher than the control values, increasing by 85,4% relative to the results recorded at rest (p<0,05). In the CG, similar results became higher by 37,8% (p<0,05). This fact greatly contributes to the optimization of adaptation to exercises performed by more energy-intensive work of a global nature involving large muscle groups in the activity.

The IOC values observed after testing in the EG were 32,4% higher than the similar results in the CG, becoming 81,5% higher relative to the data recorded at rest (p<0,05). In the CG, a similar predominance was 57,4% (p<0,05). The SI data observed after the load in the EG were 27,5% greater than the similar results in the CG, increasing by 54,5% relative to the results recorded at rest (p<0,05). In the CG, similar values became higher by 37,9% (p<0,05; Table 1). When analyzing heart rate values, we noted that the results of the EG recorded after the load were 32,4% higher than the data of the CG (p<0,05). When comparing these values with the results observed at rest, we noted the fact that in the EG they became higher by 73,2%, and in the CG they increased by 44,7% (p<0,05). This fact allows us to make an assumption about the adequate response of the athletes body to the load performed by involving various muscle groups in the activity while improving striking actions (see Table 1).

Analyzing the indicators of vegetative support of qualified athletes, we noted that at rest the data of DP indicators in the EG and CG were assessed as good when the working reserves of the heart correspond to the norm. After completing the testing task, the values of DP in athletes from the EG were 50,6% higher than the control level, having increased by 126,3% relative to the results observed at rest (p<0,05; Table 2). In boxers from the CG, the values of DP after performing striking movements increased by 67,1% (p<0,05). This fact allows us to indicate greater productivity of the heart muscle as a result of performing exercises of a global nature of muscle involvement, which implies a more significant adaptation of the body to the needs of the work performed compared to the group performing exercises of a regional nature of muscle activity. In the IMI values after completing the testing task, we recorded a predominance of values in the EG by 52,8% relative to the level of the CG (p<0,05). When comparing the values observed after testing with the data recorded at rest, we noted that in the EG the values became higher by 127,4%, and in the CG – by 64,5% (p<0,05). Analyzing these results, we made the assumption that the implementation of general physical training exercises that involve the muscles of the lower extremities in activity contributes to the development of adequate adaptive capabilities in athletes who use a playful style of fighting.

Table 2. Indicators of the influence of multidirectional functional load by means of general physical training on the vegetative support of the body of qualified athletes, X±m

Boxers of the 1st category				
Indicators	Control		Experiment	
	Peace	Load	Peace	Load
DP (conventional units)	75,9±4,2	126,8±8,2#	84,4±4,6	191±10,3*#
OSI (conventional units)	7,6±1,02	12,5±1,9#	8,4±1,3	19,1±2,2*#
CEC (conventional units)	2773,6±63,4	6598±82,1#	2817,6±71,2	9041,4±97,5*#

** – Comparison of the obtained data with the corresponding values in the CG athletes, p<0,05; # – Comparison of the obtained load data relative to the resting level, p<0,05.*

When analyzing the EEC values after performing the testing load, we noted that the results of the EG were 37% higher than the control data ($p<0,05$). The values observed in the EG athletes after exercise were 220,9% higher than the values observed at rest, and in the control group – by 137,9% (see Table 2). This fact indicates better performance of boxers from the EG, characterized by the body's expenditure on the movement of blood in the vascular bed. Taking into account the fact that the CEC values increased more significantly in the EG, we made an assumption about the significant cost-effectiveness of spending CVS reserves when using general physical training tools, which to a greater extent involve the muscles of the lower extremities in the activity of the global nature of the activity of muscle work.

Conclusions. The results of the study allow us to state that multidirectional means of general physical training, involving various muscle groups in activity, have an adequate effect on the indicators of systemic hemodynamics and autonomic support of the body in qualified boxers. Performing general physical fitness exercises with a more significant involvement in the activity of the leg muscles contributes to a more significant functioning of the hemodynamics and autonomic support of the body in the process of muscle work, which contributes to the emergence of adequate adaptive capabilities during the training process.

References

1. Antonov A.A. Gemodinamika dlya klinitsista (fiziologicheskiye aspekty). Moscow: Arkomis-ProfiTT publ., 2004. 99 p.
2. Vakhitov I.Kh. Osobennosti stanovleniya nasosnoy funktsii serdtsa detey pri myshechnykh trenirovkakh. Monograph. Kazan: TGGPU publ., 2010. 189 p.
3. Kapilevich L.V. Fiziologiya sporta. Study guide for students of higher educational institutions. Tomsk: TGU publ., 2013. 189 p.
4. Kulikov V.P. Osnovy ultrazvukovogo issledovaniya sosudov. Moscow: «Vidar-M» publ., 2015. 392 p.
5. Lozhkina M.B., Neupokoev S.N., Krivoshchekov S.G., Kapilevich L.V. Fiziologicheskiye kharakteristiki tekhniki vypolneniya ballisticheskikh udarnykh dvizheniy u sportsmenov. Fiziologiya cheloveka. 2020. Vol. 46. No. 2. pp. 47-62.
6. Smirnov V.M., Dubrovskiy V.I. Fiziologiya fizicheskogo vospitaniya i sporta. Textbook. Moscow: VLADOS-PRESS publ., 2002. 608 p.
7. Solodkov A.S., Sologub E.B. Fiziologiya cheloveka. Obshchaya. Sportivnaya. Vozrastnaya. Textbook. 3rd ed., rev., sup. Moscow: Sovetskiy sport publ., 2008. 620 p.
8. Filimonov V.I. Sovremennaya sistema podgotovki bokserov. Moscow: «INSAN» publ., 2009. 480 p.