

CONTROL SYSTEM IMPROVEMENT OF QUALIFIED BOXERS BASED ASSESSMENT SYSTEM CHANGE REACTION CARDIORESPIRATORY DURING THE IMMEDIATE PREPARATION FOR COMPETITION

Kiprych S.V.

Poltava V.G. Korolenko National Pedagogical University

Annotation. *Purpose:* Experimental verification and justification of possible practical applications of the method of assessing changes in the functional state of the boxers, based on heart rate variability and spontaneous breathing. In the future, use the results to improve the management of physical exercise in shock and competitive microcycle. *Material:* The study involved 12 masters of sport of boxing. Instrument was used Sacra. *Results:* The analysis of heart rate variability and spontaneous respiration showed individual differences changes centile distribution indicators in the management processes of fatigue - recovery cycle training sessions. *Conclusions:* The differences in the functional state of the body before exercise, during and between training sessions aftereffect. Showing differences readiness athletes to training sessions, the reaction of the organism to the load activation of redox reactions.

Keywords: functional, state, variability, heart rate, spontaneous, breathing.

Introduction

Up-to date methods of evaluation of sportsmen's functional potentials are based on two main approaches. The first approach is connected with evaluation of functional provisioning of sportsmen's workability. These measurements are carried out in the process of fulfillment of tests. They reflect quantitative and qualitative changes of sportsmen's general and special physical fitness [7]. This approach permitted to receive solid results, which facilitated to formation of scientific-methodic principles of control of sportsman's training, including in boxing [8, 14]. The second approach is connected with estimation of sportsmen's functional condition in certain conditions of sport trainings, for example with preparation for start or in recreational period after intensive training or competition loads [6]. Systemizing of such approaches permitted to obtain serious results, which permitted to form scientific-methodic principles of control of sportsmen's training, oriented on development of different sides of sportsmen's functional potentials [12, 13], as well as on optimization of organism's tiredness and recreation in training cycles [2, 5].

At the same time there appeared understanding of the fact that received information about adaptation changes in sportsman's organism in trainings can be significantly increased on the base of analysis of quantitative and qualitative changes of correlation "doze-effect", of influence of specially targeted physical loads [1]. They are especially informative criterion of correspondence of achieved and desired trainings' effects; they reveal the sense of integration of external and internal loads' sides, reflect inter-connections between workability, organism's reactive abilities and achieved training results [9].

Thus, it permits to regard quantitative and qualitative criteria of "doze-effect" correlations, as well as achieved load's parameters, in system of improvement of means and methods of highly qualified sportsmen's training [3, 4, 15], as well as to use them for working out of new methods of control of qualified sportsmen's training process [11].

Especially it is important to work out such criteria for certain conditions of sport trainings, considering their target orientation. In certain case it can be actual to work out criteria of complex evaluation of sportsman's pre-start fitness, of organism's responses to loads and level of recreational processes' activation. New criteria can be based on evaluation of boxers' functional condition in the morning, in day of training with high load, just after such training and next morning.

Purpose, tasks of the work, material and methods

The purpose of the work is experimental testing and foundation of possibility of practical application of sportsmen's functional condition's evaluation by indicators of heart beats rate and spontaneous breathing for improvement of physical loads' regulation in training micro-cycles.

The work has been fulfilled as per combined plan of SRW in field of physical culture and sports for 2011-2015 by topic 2.9. "Individualization of training process of qualified martial arts sportsmen".

The methods and organization of the research. 12 qualified sportsmen (masters of sports) participated in the researches. They belonged to weight categories 50.802 – 86.01 kg.

Analysis of variability of heart beats frequency (HF) and respiratory system was fulfilled with the help of device "SAKR" [7]. We analyzed indicators, which reflected total capacity of HF variability and general condition of regulating functioning of autonomous nervous system – TP. TP indicators characterized peculiarities of reconstructions of cardiac functioning's vegetative provisioning under influence of intensive physical loads as well as its functional reserve's condition. We also analyzed indicators of sympathetic (LF) and para-sympathetic regulations of HF. Simultaneously with heart rate we calculated spectral characteristics of air flow speed and spiro-gram of averaged breathing cycle. For spiro-gram of averaged breathing cycle we calculated: time of inhale (T_{inh}), time of exhale (T_{exh}), speed of exhale (BV/T_{exh}), breathing volume (BV). Spectral characteristics of volume speed of air flow were calculated

by three main spectral components: especially low-frequency VLF, low-frequency – LF, high-frequency – HF and total variability of volume speed of air flow – TP.

The researches were conducted in period of pre-competition training (one week before competitions). We considered that in this period sportsman's organism is the most sensitive to changes in breathing homeostasis [10]. Measurements were carried out in the process of evaluation of sportsmen's readiness for start, after hard physical loads, in period of activation of organism's re-creational functions.

Results of the researches

Analysis of mean indicators of heart rate's regulation (see table 1) witnesses about presence of high functional reserve of organism. Shifting of median and other statistic indicators TP and LF to upper levels of centile distribution (CD) witnesses about increased influence of sympathetic cardiac rate's regulation. Analysis of correlation of sympathetic and para-sympathetic parameters of heart rate's regulation points at domination of sympathetic regulation LF/HF, ms^2/ms^2 , with it level of correlations preserves in dynamic of measurements 2,9; 2,7; 2,7 conv.un. that corresponded to 4th level of centile distribution of limits of heart rate's parameters. With it, variations' coefficients (CV) were accordingly 74,0%; 43,0%; 65,4%. Characteristic features of correlation LF/HF, with high level of individual differences, points at need in structural analysis of heart rate's variability on the base of differentiated consideration of the mentioned characteristics.

Analysis of centile distribution of indicators of CP capacity's variability and general condition of regulating functioning of autonomous nervous system (TP) showed that indicator reduced (median's shifting from 4th to 2nd level of CD after training); with it in recreational period this indicator increased and returned to initial level. With general trend's of CD remaining unchanged analysis of LF and HF medians witnesses about increased influence of sympathetic regulation of heart rate. Indicators of sympathetic regulation are at higher level of centile distribution than indicators of para-sympathetic. It is naturally reflects in process of first two changes, when we speak about increased mobilization of organism's functions. At the same time we noted that in third measurement level of sympathetic regulation increases (4th level of CD median restores), with it level of para-sympathetic influences increases insignificantly (shifting from 2nd level to 3rd). With it coefficients of variation (CV – TP, LF, HF) were accordingly 40,1-68,2% – in the morning after sleep; 71,2-77,8% – after training; 54,1-64,1% – in the morning after sleep, next day. Indicators of variations witness about higher level of individual differences of heart rate parameters' correlations.

Table 1

Indicators of boxers' heart rate (n=12)

Statistic	Indicators of heart rate's regulation		
	TP, ms	LF, ms	HF, ms
First day: measurements in the morning after sleep			
X	111.4	99.5	34.6
Me	123.7	110.7	23.2
S	45.5	40.9	23.6
25%	81.5	77.2	21.1
75%	138.5	122	43.8
First day: measurements after training			
X	66.76	59.7	21.9
Me	47.8	41.8	14.6
S	47.9	45.11	16.9
25%	32.6	27.7	9.4
75%	111.9	102.7	33.7
Second day: measurements in the morning after sleep			
X	105.75	93.8	34.9
Me	117.2	112.6	29.6
S	54.0	50.6	22.4
25%	62.1	56.3	22.8
75%	135.7	127.1	44.5

Evaluation of breathing responsiveness was fulfilled on the base of analysis of breathing variability in standard conditions of rest. Sportsmen fulfilled 6 cycles – inhale-exhale.

Indicators of variability of spontaneous breathing are presented in table 2.

Table 2

Показатели реактивности системы дыхания

Statistic	TPSP, l/m	VLFSP, l/m	LFSP, l/m	HFSP, l/m	T _{insp} , s	T _{exp} , s	V _{insp} , l	V _{insp} /T _{exp}
<i>First day: measurements in the morning after sleep</i>								
X	33.27	4.06	28.60	14.96	3.67	5.85	2.05	0.35
Me	28.00	3.90	25.20	12.00	4.12	5.57	1.98	0.34
S	16.86	1.81	13.83	10.02	0.99	0.70	0.73	0.11
25%	21.10	2.20	19.50	6.90	2.56	5.38	1.55	0.29
75%	43.80	5.60	32.70	26.50	4.57	6.53	2.32	0.41
<i>First day: measurements after training</i>								
X	35.52	4.18	28.45	17.23	3.37	5.76	1.80	0.32
Me	31.80	4.25	27.65	13.45	3.60	5.74	1.84	0.26
S	13.45	1.64	13.19	9.42	1.34	1.72	0.74	0.14
25%	26.10	2.75	21.20	9.10	2.31	5.15	1.34	0.22
75%	45.40	5.70	37.20	25.05	4.57	6.65	2.29	0.44
<i>Second day: measurements in the morning after sleep</i>								
X	29.93	3.63	23.33	15.26	3.91	5.16	1.78	0.37
Me	23.90	3.30	21.50	9.90	4.46	5.35	1.76	0.29
S	14.08	2.12	11.64	10.11	1.20	1.51	0.79	0.19
25%	20.80	2.20	16.20	7.60	3.31	4.96	1.24	0.23
75%	43.10	4.10	28.10	21.60	4.72	5.42	2.18	0.42

The character of centile distribution of inhale and exhale time, of inhale volume pointed at high level of response in general. Reducing of median's level with centile distribution was registered only by indicators of inhale-exhale correlation. It is evident that evaluation of respiratory system's responsiveness requires detail analysis of breathing structure (variability).

Evaluation of median with the help of CD pattern of spontaneous breathing witnesses about dominating of indicators of total capacity of variability of volume speed of air flow (TP), VLF and LF spectral components of breathing rhythm. It is also stressed by indicators, which correspond to upper (5th) level of CD. With it we registered trend, with which level of CD indicators reduces in the process of third measurement (at the next morning). It is natural owing to specific character of correlation of tiredness's processes – recreation in analyzed cycle of training.

At the same time analysis of HF median's distribution witnesses about preservation of reduced centile distribution's level during all period of measurements, including period of recreation after load.

Coefficients of variation (CV) of all indicators of breathing variability were accordingly: 31,5-70,0% – in the morning after sleep; 37,9–54,6% – after training; 29,3–58,4% – in the morning after sleep, the next day. Indicators of variation coefficients witness about high level of individual differences of correlation of heart rate regulation's parameters.

Discussion of results of the research

In general, analysis of results of heart rate variability and breathing indicators showed adequate response of sportsman accordingly to period of measurements (before, at the moment and 12 hours after loaf) and targets of training process in period of pre-start trainings.

The character of centile distribution of mean indicators, which reflected total capacity of HR variability and general condition of autonomous nervous system's regulating functioning as well as sympathetic and para-sympathetic regulations witnesses about functional readiness to tensed motion functioning of sportsmen (measurements were fulfilled one week before important start). This is proved by high level of mobilization readiness and level of load's enduring of boxers (absence of great functional shifts in organism) in the process of training, oriented on development of boxers' special endurance. At the same time analysis showed that level of indicators and character of correlation of

median's (HF) centile distribution in the process of three measurements witness about presence of reserves, connected with seeking of ways for additional activation of recreational processes in post-competition period.

At the same time the presented data witness about high level of individual differences of all indicators of heart rate regulation in homogeneous group of sportsmen. The problem is that with high level of indicators' individual differences there is practically no possibility to determine group trends in correlation as well as changes of correlations of sympathetic and para-sympathetic regulations of heart rate during all period of measurements. It significantly reduces possibilities of evaluation of organism's general (group) laws of response to training loads during measurement cycle before training, after training and in the morning, next day after training in homogeneous group of sportsmen.

It is evident that with absence of definite group laws evaluation of effectiveness of heart rate regulation, correlation of sympathetic and para-sympathetic processes in organism and connected with it evaluation of correlation of tiredness and recreational processes' activation can be analyzed, considering individual or typological features of sportsmen.

Characteristics of tiredness-recreation are a part of analysis of changes of sportsmen's functional condition under influence of physical loads. Naturally, there appears a question about evaluation of readiness or not readiness to realization of their functional potential degree in the process of training and competition functioning. In this connection HR indicators can be supplemented by characteristics of breathing responsiveness, which, in complex, reflect organism's ability to quickly, adequately and to full extent respond to physical loads that exactly is a target of sport training in conditions of actively alternating competition functioning, typical for modern boxing [10].

In this connection, one of the most informative criteria of evaluation of sportsmen's respiratory system's responsiveness and, as a result, of ability to mobilization, realization and recreation of functions are changes of responsive abilities of KPC, in particular breathing response. With it it is well known that structure of breathing response, pattern and variability of spontaneous breathing in rest, with its evaluation together with indicators of heart rate regulation have great degree of interconnection with responsive abilities of blood circulation system, its sensitivity to hypoxia and hypercapnia of load [4].

With stating of single effect of influence the existing criteria of evaluation of breathing pattern do not always give full picture about changes of functions, which characterize potentials of formation of required adaptation effect under influence of physical loads. It is well known that the highest realization effect of load takes place only, when single cycle of stimulation and recreational influences is realized. In general form this cycle is described in special literature [2]. This cycle switches on a system of means of workability's pre-start stimulation, workability's stimulation in the process of trainings and competition functioning, correction of tiredness after high physical loads. In compliance with it the necessary criteria of effectiveness of adaptation processes, i.e. complex evaluation, including evaluation of fitness or not-fitness of sportsmen for start, sportsman's condition after tensed training and competition functioning. Differences in sportsman's condition will permit not only to determine the level of load's influence on, "doze", but also its effect, connected with activation of recreational processes and formation, on this base, conditions for favorable adaptation to loads.

Analysis of changes of blood circulations system's responsiveness also showed significant range of individual differences in the process of all measurements. It, naturally, witnesses about need in analysis of individual data. Nevertheless, for foundation of conception we carried out analysis of changes of mean statistic indicators of median of breathing variability's indicators.

Analysis of changes of breathing responsiveness witnesses about high mobilization potentials of sportsmen. High level of responsiveness remained in the process of training. Simultaneously we stated that level of breathing response (by characteristics of sympathetic regulation) remained the same after load. Probably, it is connected with increased tension of function after training and reduced activation of recreational processes. It is also proved by high frequency parameters of breathing variability (HFSP), as well as by results of evaluation of heart rate variability, presented above.

Analysis of individual changes of all blood circulation system's indicators during training cycle permitted to mark out different types of responses to loads and, accordingly, different correlations "doze-effect" influence, which can appear under influence of single-type load for sportsmen of homogeneous group.

The first type is characterized by high level of mobilization fitness, sufficient depth of load's influence on organism and activation of recreational processes, by optimal correlation of "doze-effect" influence.

The second type also is characterized by high level of mobilization fitness, sufficient depth of load's influence on organism. With it we noted reduced level of recreational responses during first phase of recreational period. This type is characterized by increased tension of function and requires using of wider spectrum of recreational means.

The third type is characterized by reduced level of organism's mobilization fitness, by higher tiredness, achieved in the process of load and, as a result, by reduced level of recreational responses. This type is characterized by not readiness of organism's functional systems to tensed physical load.

The obtained results can be substantial supplement to existing criteria of effectiveness of sportsmen workability's functional provisioning. They can become the basis of foundation of new load's conditions and targeted stimulation of adaptation processes with preparation to start, in the process of trainings, in period of recreation and preparation to following stage of training and competition functioning [4].

Conclusions:

1. When testing of qualified boxers of homogeneous group with the help of instrument “SAKR”. We determined typological features of parameters of heart rate and breathing response before load, in the process and in period of after-effect of training’s load.

It was noted that combined evaluation of heart rate variability and spontaneous breathing gives picture about level of activation of starting mechanisms of functional provisioning of workability, level of functions’ mobilization in the process of training and activation of recreational responses in period of after-effect of great training loads. It is new mean of realization of control as function of training loads’ monitoring in the process of development of sportsmen’s special workability.

2. In the process of all periods of measurements we registered high level of individual differences of heart rate variability and spontaneous breathing. It points at differences in organism’s responses to homogeneous group sportsmen’s load in identical conditions of training and, as a result, proves demand in such analysis on the base of evaluation of correlation of individual indicators, taken in all three measurements’ periods.

3. On the base of evaluation of changes of heart rate variability and spontaneous breathing in the cycle of sport training we can receive data about quantitative and qualitative indicators of correlation of tiredness processes – recreation of organism in the process of development of boxers’ special development that is the basis for individualization of training process in system of current control of sport training in important and competition micro-cycles.

An urgent direction of research on this topic is analysis of changes of “doze-effect” influence in training meso-cycle.

References:

- 1 Bulgakova N., Volkov N., Popov O., Samborskij A. *Nauka v olimpijskom sporte* [Science in Olympic Sport], 2006, vol.1, pp. 55–59.
- 2 Vinogradov V. E. *Stimuliaciia rabotosposobnosti i vosstanovitel'nykh processov v trenirovochnoj i sorevnovatel'noj deiatel'nosti kvalificirovannykh sportsmenov* [Stimulation efficiency and reduction processes in training and competitive activities qualified athletes], Kiev, NPF Slavutich Dolphin, 2009, 367 p.
- 3 D'iachenko A.Iu. *Sovershenstvovanie special'noj vynoslivosti kvalificirovannykh sportsmenov v akademicheskoi greble* [Improving special endurance trained athletes in rowing], Kiev, NPF Slavutich Dolphin, 2004, 338 p.
- 4 Mishchenko V.S., Lysenko E.N., Vinogradov V.E. *Reaktivnye svoystva kardiorespiratornoj sistemy kak otrazhenie adaptacii k napriazhennoj fizicheskoi trenirovke v sporte* [Reactive properties of the cardiorespiratory system as a reflection of adaptation to strenuous physical training in sport], Kiev, Scientific World, 2007, 351 p.
- 5 Platonov V.N. *Teoriia periodizacii sportivnoi trenirovki* [Theory of periodization of athletic training], Kiev, Olympic Literature, 2013, 624 p.
- 6 Romanchuk A. P., Noskin L. A., Pivovarov V. V., Karganov M. Iu. *Kompleksnyj podkhod k diagnostike sostoiianiia kardiorespiratornoj sistemy u sportsmenov* [Integrated approach to the diagnosis of the cardiorespiratory system in athletes], Odessa, Phoenix, 2011, 255 p.
- 7 Mak-Dugal D. *Fiziologicheskoe testirovanie sportsmenov vysokogo klassa* [Physiological testing of high-class athletes], Kiev, Olympic Literature, 1998, 431 p.
- 8 Filimonov V. I. *Sovremennaia sistema podgotovki bokserov* [The modern system of training boxers], Moscow, INSAN, 2009, 480 p.
- 9 Shirkovec E.A., Shustin B.N. *Teoriia i praktika fizicheskoi kul'tury* [Theory and practice of physical culture], 1999, vol.1, pp. 28-30.
- 10 Babb T., DeLorey D.S. Hyperventilation with He-O(2) breathing is not decreased by superimposed external resistance. *Respiratory Physiology & Neurobiology*. 2002, vol.133(1-2), pp. 139-144.
- 11 Bastian M. *Studies on the structure and dynamics of competition achievements in amateur boxing* [Untersuchungen zur Struktur und Dynamik der Wettkampfleistungen im Amateurboxen], Frankfurt/Oder. 1998, pp. 112-117.
- 12 Kessler J., Smith M. Boxing psychology - why fights are won and lost in the head. *Journal of Shenyang Institute of Physical Education*. 2008, vol.27(2), pp. 53-58.
- 13 Mischenko V., Monogarov V. *Physiology athlete* [Physiology del deportista], Editorial Paidotribo. 1995, 328 p.
- 14 Christopher J. Gore. *Physiological tests for elite athletes*. Australian Sports Commission. 2000, 403 p.
- 15 Takahashi T., Hayano J., Okada A., Saitoh T., Kamiya A. Effects of the muscle pump and body posture on cardiovascular responses during recovery from cycle exercise. *European Journal of Applied Physiology*. 2005, vol.94(5-6), pp. 576 – 583.

Information about the author

Kiprych S.V.: ORCID: 0000-002-9226-5713; kiprych@ukr.net; Poltava V.G. Korolenko National Pedagogical University; Ostrogradskii str. 2, Poltava, 36000, Ukraine

Cite this article as: Kiprych S.V. Control system improvement of qualified boxers based assessment system change reaction cardiorespiratory during the immediate preparation for competition. *Physical education of students*, 2014, vol.4, pp. 26-31. doi:10.6084/m9.figshare.996011

The electronic version of this article is the complete one and can be found online at: <http://www.sportpedagogy.org.ua/html/arhive-e.html>

This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (<http://creativecommons.org/licenses/by/3.0/deed.en>).

Received: 13.02.2014
Published: 27.02.2014