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ANALYSIS OF FUNCTIONAL CONDITION OF CARDIORESPIRATORY SYSTEM OF QUALIFIED AND ENTRANT WEIGHT LIFTERS

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Abstract

This article provides data of the analysis of functional condition of cardio respiratory system of qualified and entrant weight lifters.

Keywords: weight lifters, functional condition of cardio respiratory system, determination of maximum oxygen uptake, vital lung capacity, variability of heart rate

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АНАЛИЗ ФУНКЦИОНАЛЬНОГО СОСТОЯНИЯ КАРДИОРЕСПИРАТОРНОЙ СИСТЕМЫ КВАЛИФИЦИРОВАННЫХ И НАЧИНАЮЩИХ ГИРЕВИКОВ

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Аннотация

В статье приведены данные анализа функционального состояния кардио-респираторной системы квалифицированных и начинающих гиревиков.

Ключевые слова: гиревики, функциональное состояние кардио-респираторной системы, определение максимального потребления кислорода, жизненная емкость легких, вариабельность сердечного ритма.

Study of regularities of the process of organism's adaptation to various conditions of the environment is

one of the key problems of modern physiology. Adaptation to any human's activity is a complex and

multilayer process that touches various functional systems of organism [5]. In terms of physiology adaptation to muscular work is a system response of the organism, directed at achievement of high training and minimization of physiological penalty for it. Adaptation to physical activity is considered as dynamic process, on the base of which formation of new program of reaction lies, while adaptive process itself, its dynamics and physiological mechanisms are defined by condition and correlation of internal and external condition of activity [6, 7].

In terms of effect on the human body, weight lifting is one of the most powerful kinds of sport. Dedicated weight lifting activities favor development of strength endurance and increase of physical efficiency. During training process and competitions, weight lifters experience significant static and dynamic loads, which are performed during long periods of time. Such loads make special requirements to sportsmen's organisms, and especially their cardiorespiratory systems. It is known that balanced sport activities cause some positive changes in morphology and function of cardio respiratory system [4]. Detection of such changes in weight lifters is of scientific interest.

The subject of the research: to detect distinctions in functional condition of cardio respiratory system of qualified and entrant weight lifters.

Materials and methods of research

Six qualified weight lifters took part in the study, who were students and Master's degree students of the Faculty of Physical education of Belgorod State National Research University, winners of Championship of Russia among students of 2015 (one Honored Master of sports of Ukraine, one Master of sport of Russia of international level, two Masters of sport, two Candidate Master of sports) at the age of 17-26 and six entrant weight lifters at the age of 16-28.

For determination of maximal oxygen uptake (MOU), bicycle ergometer Monark Ergonomic 839E (Sweden) was used with execution of Astrand protocol, in which assessment of MOU is performed in the base of submaximal operational load.

The value of vital lung capacity (VLC) was defined with the help of portable microprocessor Spirograph SMP-21/01-R-D (Russia).

Study of variability of heart rate was performed after 10-minute rest, at quiet breathing. Registration was performed in fasting state or in 1.5-2.0 hours after food intake.

For examination of variability of heart rate, 'Biomouse' hardware-software complex (Russia) was used, which allows performing graphical registration

and mathematical processing of photoplethysmograms. The following indicators of heart rate were analyzed:

Heart rate (HR);

Duration of mean RR interval;

Duration of maximal and minimal RR interval;

Range (R) – difference between maximal and minimal values of RR interval. R is considered as parasympathetic indicator. Normal values for R equal 0.15 to 0.45 [1-3].

Mode (Mo) is a range of values of the most frequently encountered cardiac signals. It points at dominating level of functioning of sinoatrial node;

Mode amplitude (AMo) is a correlation of the number of RR-intervals with the values that equal Mo, to overall number of RR intervals in percent. Normal values equal 30-50%.

Index of intenseness of regulatory systems (II) reflects the level of centralization of managing heart rate. In normal state, it equals 50 to 150 relative units [1-3]. This indicator is sensitive to increase of tonus of sympathetic nervous system.

Index of vegetative balance indicates at correlation between activities of sympathetic and parasympathetic parts of VNS. Normal values equal 35 to 145 relative units.

Vegetative index of rhythm allows estimating vegetative balance in terms of autonomous regulation circuit.

Index of regulatory processes' activity (IRPA) reflects correlation between activity of parasympathetic part of VNS and leading level of functioning of sinoatrial node. Normal values are within the range of 15 to 50 relative units.

High-frequency component of spectrum (HF) reflects dominating role of parasympathetic part of VNS in formation of variations in frequency range [8-10]. Power in this frequency range increases during breathing with a certain rate and depth.

Low-frequency component of the spectrum (LF). Physiological interpretation of this indicator is questionable. It is assumed that power in this frequency range is influenced by changes of tonus in parasympathetic and sympathetic parts of vegetative nervous system [8-10].

Relation LF/HF characterizes correlation of sympathetic and parasympathetic influences; at the same time, at increase of tonus of sympathetic part this index increases significantly, and at vagotony – vice versa. It was stated that LF power significantly increases at psychological stress, moderate physical activity in healthy people; that's why recently popular is a viewpoint that power in LF range, as much as LF/HF index, reflect the activity of sympathetic part of VNS [2].

Results of the research and their discussion

One of universal and informative methods of definition of sportsmen's functional condition is determination of MOU, the level of which is closely connected with working efficiency of cardio respiratory system and bioenergetic processes in organism at muscular activity [4]. In our researches we detected high level of MOU in highly qualified

weight lifters and medium one – at entrant weight lifters ($p < 0.05$) (Table 1).

Lung capacity (VLC) as an indicator of development of external respiration apparatus in qualified and entrant weight lifters corresponded to appropriate values. No statistically significant differences were detected between the groups.

Table 1

Indicators of functional condition of cardio respiratory system of weight lifters (M±m)

Indicators, measurement units	Qualified weight lifters	Entrant weight lifters	t	p
MOU, ml/kg/min	56.2±4.85	43.1±2.35	2.43	<0.05
VLC, l	5.5±0.32	5.1±0.34	0.86	>0.05
Heart rate, bpm	58.2±2.36	78.4±3.02	5.27	<0.05
Medium RR interval, ms	1036.1±43.71	771.4±28.62	5.07	<0.05
Min. interval, ms	890.3±41.03	664.9±21.59	4.86	<0.05
Max. interval, ms	1158.1±42.79	915.3±44.76	3.92	<0.05
Range, ms	267.8±33.30	250.4±24.34	0.42	>0.05
Medium fluctuation, ms	63.3±10.77	52.2±6.73	0.87	>0.05
Mode, ms	1065.0±53.65	767.9±22.68	5.10	<0.05
Mode amplitude, %	32.5±4.59	37.6±3.90	0.85	>0.05
Intention index (II), relative units	61.8±16.52	113.1±22.08	1.86	>0.05
Vegetative balance index (VBI), relative units	130.2±33.48	168.1±30.39	0.84	>0.05
Index of activation of regulation processes (IARP), relative units	33.48±4.72	49.6±5.29	2.27	<0.05
Vegetative rhythm index (VRI), relative units	3.8±0.43	5.7±0.76	2.18	>0.05
HF, ms	209.2±32.62	179.9±20.41	0.76	>0.05
LF, ms	128.2±28.11	100.3±16.78	0.85	>0.05
HF / LF	1.7±0.26	1.9±0.20	0.61	>0.05

Dynamic characteristics of heart rate allow assessing intensity of switches of sympathetic and parasympathetic activity of vegetative nervous system at changes of human's physical state [1-3, 8].

Mean value of HR at rest in highly qualified weight lifters is significantly lower than the values obtained from entrant sportsmen ($p < 0.05$). This speaks of increase of tonus of parasympathetic part of vegetative nervous system and economization of functions of cardiovascular system. In addition, there is a statistical significance in indices of RR intervals' lengths and associated Mode values in qualified and entrant weight lifters. Index of intensity of regulatory systems (II) is within the range of normal values in both groups of sportsmen. Index of activity of regulation processes (IARP) is much lower in highly qualified sportsmen as compared to entrant sportsmen ($p < 0.05$). Vegetative index of rhythm and spectral characteristics of heart function's variability in both groups are within normal limits and do not have any statistical differences.

Conclusion

Functional condition of cardio respiratory system of qualified weight lifters differs greatly from the one of entrant weight lifters upon many indicators (MOU, HR, length of RR interval, Mode and other indicators of heart rate variability). These differences are connected with morphological and functional adaptive changes in their organisms. The result of such changes is obtainment of high training.

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