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The use of bioresonance therapy in the correction of the athlete's overtraining syndrome

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Rationale. Excessive physical activity leads to exhaustion and disruption of the functions of organs and systems, which det to disadaptation, vegetative imbalance and disruption of the cardiovascular, nervous, endocrine and other systems, forming the syndrome of overtraining. In this regard, it is pathogenetically justified to use physiotherapeutic non-invasive methods for correcting physiological parameters and psycho-emotional status, one of which is bioresonance therapy (BRT).**Purpose of the study**— to study the effect of BRT on the condition of athletes with overtraining syndrome.**Methods.**The study included 60 athletes with overtraining syndrome, divided into two groups of 30 people (the groups were comparable in age, gender, sport and sports qualification). The 1st (main) group included athletes, in whose rehabilitation treatment BRT was used, the 2nd (control) group, who received placebo procedures. All athletes before and after treatment underwent a complex of clinical-functional, instrumental research methods.**Results.**The use of BRT significantly increases parasympathetic influences on the heart rhythm, reduces the intensity of the central circuit of its regulation; contributes to the economization of cardiac activity; has a hypotensive effect, more pronounced in relation to systolic blood pressure (BP), has a normalizing effect on BP variability in patients with its initial instability, significantly reduces the time index when monitoring BP, and also has a normalizing effect on its daily rhythm and the speed of morning rise in diastolic blood pressure.**Conclusion nie.**BRT can be considered as a method for correcting the overtraining syndrome in athletes with increased increased activity of the sympathetic nervous system.

Keywords:*overtraining syndrome, athlete, recovery, physiotherapy, bioresonance therapy.*

The application of bioresonance therapy for the correction of the overtrained athlete syndrome

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background. Physical overload results in the development of pathological changes in the organs and systems and thereby causes their dysfunction. This leads to disadaptation, vegetative imbalance, and disturbances in the cardiovascular, nervous, endocrine and other systems. Taken together, these changes give rise to a syndrome of overtraining. In this context, the pathogenetically sound method of therapy appears to be the most suitable for the management of this condition based on the physiotherapeutic non-invasive interventions for the correction of physiological characteristics and the psycho-emotional status of the patients. One such method is bioresonance therapy (BRT).**Aims.**The objective of the present study was to evaluate the influence of bioresonance therapy (BRT) on the health status of the athletes presenting with the overtraining syndrome.**materials and methods.**The study included 60 athletes presenting with the overtraining syndrome. They were divided into two groups each comprised of 30 subjects of comparable age, sex, sport, and sports qualification. Group I was composed of 30 athletes who were treated by means of bioresonance therapy. Group II (control) contained the athletes who received placebo procedures (ie the procedures with the use of a non-functioning device). All the athletes were examined before and after the treatment with the application of the clinical and instrumental methods.**results.**The study has demonstrated that the use of bioresonance therapy significantly increases the parasympathetic influence on the rhythm of the heart, reduces the stress on the central contour of its regulation, contributes to the "economization" of the cardiac activity; has an antihypertensive effect (more pronounced with respect to systolic blood pressure (SBP)), has a normalizing effect on the variability of blood pressure (BP) in the patients with initial BP instability, and significantly decreases the time index in connection with blood monitoring pressure; moreover, BRT has a normalizing effect on the circadian rhythm of BP and corrects the rate of the morning rise in diastolic blood pressure (DBP).**Conclusions.**Bioresonance therapy can be considered as a method for the correction of the syndrome of overtraining in the athletes with the enhanced activity of the sympathetic nervous system.

keywords:*the overtraining syndrome, athletes, recovery, physiotherapy, bioresonance therapy.*

Rationale

Significant sports achievements in recent decades are accompanied by a significant increase in the amount of physical activity among athletes. At the same time, an increase in the volume and intensity of training is often considered as the only guarantee of an athlete's success [1]. At the same time, as a result of irrational training, for example, in a painful state or during a period of convalescence, with volumes and intensity of loads that do not correspond to the capabilities of an athlete, a state of overtraining may occur [2, 3]. Overtraining is a condition characterized as a pathological condition that occurs in athletes against the background of chronic physical overstrain, the clinical manifestations of which determine disorders in the central nervous and cardiovascular system (CVS) of a predominantly functional nature [4].

Since the 80s of the last century, the main role in increasing the general nonspecific activity of the body has been played by methods and means that accelerate the adaptation of athletes to physical activity, while preventing the development of maladjustment disorders. The need for the use of pharmacological agents and the high efficiency of their effect on the metabolism of cells and tissues of the body, adapting them to long-term work at a high level, have been confirmed [6]. The reasonable use of pharmacological drugs by athletes over the past two decades has increased the physiological capabilities of the athlete's body to the limit, which contributed to the growth of interest in the use of non-drug methods. As one of the methods used to restore and correct the physical condition,

BRT is based on the principle of coordinating the mode of action of the physical factor and the rhythms of physiological processes in the body [8]. The currents generated by the device in the range from 4096 to 32768 Hz, modulated in amplitude and frequency, cause resonant oscillations of intracellular structures in the body, leading to the normalization of bioelectrical, biochemical and regulatory processes. Clinically, this is manifested by a number of therapeutic effects, including hypoalgesic, vasoactive, and metabolic ones [9, 10–13]. All of the above determined the purpose of this study.

The aim of the study was to study the effect of BRT on the condition of athletes with overtraining syndrome (OT).

Methods

The study was conducted in Branch No. 1 (Sports Medicine Clinic) of the Moscow Scientific and Practical Center for Medical Rehabilitation, Restorative and Sports Medicine of the Moscow Department of Health. For the period from January 2014 to June 2017, 60 highly qualified athletes involved in cyclic sports were examined, i.e. loads with a predominantly aerobic metabolism (cross-country skiing, swimming, cycling, etc.). Among the subjects, there were 43 men and 17 women aged 16 to 35 years (mean age 26±3.8 years), who had symptoms of overtraining. In 95% of athletes, increased activity of the sympathetic department of the nervous system was established. Exclusion criteria for the study were any clinically significant organic pathology,

All surveyed athletes with SP were randomly divided into two groups of 30 people (groups were comparable in age, gender, sport and sports qualifications). The sports qualification of the surveyed mostly corresponded to the candidates for master of sports and masters of sports. The 1st (main) group included athletes, in whose rehabilitation treatment BRT was used, the 2nd (control) group included those examined, who received placebo procedures (procedures with the machine turned off). BRT procedures were performed using a Bicom optima 5.0 device (Germany). The electromagnetic vibrations of the athlete's body were recorded using electrodes and transmitted to the input of the BRT device, having undergone special processing (spatio-temporal, frequency, nonlinear filtering, separation). Further, the oscillations were transmitted to the athlete with the help of electrodes. Programs used throughout the course: basic therapy (wave frequency 84 kHz), stimulation program (wave frequency 139 kHz), non-specific therapy (wave frequency 111 kHz) to normalize the state of the autonomic nervous system. The course of treatment consisted of 11 procedures: the first 5 procedures after 1 day, then 3 procedures after 2 days and 3 procedures after 3 days.

Before and after treatment, all athletes underwent a complex of general clinical, clinical, functional and instrumental research methods: HRV was studied using a Polyspectr-8 vegetative tester (Neurosoft, Russia) in the morning.

nie hours after a 10-minute rest with the registration of the electrocardiogram in the supine position for 5 minutes; analysis of the daily graph of changes in blood pressure (BP) was performed using the method of daily monitoring using a portable system SHILLER BR-102 PLUS (Germany); the state of the cardiorespiratory system during exercise was assessed by performing a stepwise increasing test with physical activity on a MONARK 839 bicycle ergometer (Sweden) using the Oxycon Pro system with gas analysis functions (ergospirometry) as a recorder and recording the electrical activity of the myocardium in 12 management in real time. Psychological status was assessed using the Profle of Mood States (POMS) test.

This study was approved by the local ethics committee of the Moscow Scientific and Practical Center for Medical Rehabilitation, Restorative and Sports Medicine of the Moscow Department of Health (minutes of the meeting No. 3 dated January 27, 2014). All patients signed a voluntary informed consent to participate in the study.

The obtained data were statistically processed using the Ofce Excel 2010 (Microsoft, USA) and Statistica 10 for Windows (StatSoft, USA) software package. Parametric data are presented as the arithmetic mean (*M*) and its standard error (±*m*). To determine the reliability of the dynamics of variables, we used *t*-Student's criterion. Differences between the two mean values were considered significant at $R<0.05$.

results

Main results of the study

At the first stage, the clinical and functional state of athletes with SP was studied, who complained of a constant feeling of rapid fatigue, headaches in the frontotemporal and occipital regions, increased heart rate at rest, discomfort in the heart area, sometimes interruptions in the work of the heart, instability of blood pressure, emotional lability, decreased mood background, sleep disturbances, decreased appetite, unexplained decrease in sports performance, slow recovery after habitual physical exertion. When examining athletes by general clinical methods, no obvious pathology was revealed.

HRV studies revealed the following feature: a decrease in the RR interval to 879.8±6.6 ms (healthy athletes 938.4±5.7 ms; $R<0.001$). A decrease in HRV is an indicator of autonomic imbalance and is prognostically unfavorable.

a clear sign of possible cardiovascular complications.

A low level of SDNN (standard deviation of the values of normal RR intervals) was revealed, indicating the activation of sympathetic regulation. SDNN was 37.5±2.1 ms (healthy athletes 59.7±5.2 ms; $R<0.001$). The study showed that vegetative imbalance in the group of athletes with increased activity of the sympathetic part of the nervous system was detected in 95% of the examined and was formed on the basis of a significantly lower level of parasympathetic activity of the HF spectrum — 445.7±156 ms_2 (healthy athletes 976±205 ms_2; $R<0.02$). An analysis of relative indicators that determine the percentage contribution of individual components to the total power of the spectrum revealed the following distribution: in 87.5% of cases, there was a significant increase in the activity of the VLF component, which indicates an increase in the intensity of regulatory centers as one of the indicators hyperactivity of the sympathetic nervous system. At the same time, a significant increase in LF (relative increase in sympathetic activity) was detected in 84% of cases. The combination of an increase in the spectral power of LF and VLF (56.6%) can be interpreted as an absolute increase in sympathetic activity.

When analyzing the normalized spectrum indices (LF and HF), a significant predominance of the activity of the sympathetic nervous system was noted in the form of an increase in the LF value of 71.2±1.5 nu (healthy athletes 54.1±3.2 nu; $R<0.001$). The index of centralization (CI), which determines the ratio of the central circuit of regulation to the autonomous circuit, was increased to 6.0 ± 0.9 arb. units. (healthy sportsmen 2.2±0.8 standard units; $R<0.01$). Indicators of tension index (TI) of regulatory systems were increased up to 171.2±10.1 arb. units (healthy athletes > 150 conv. units). According to the literature, this indicator is an indicator of increased tone of the sympathetic nervous system [14].

According to the data of daily monitoring of blood pressure, an increase in its daily variability was noted in more than 75% of cases. A significant change in BP variability per day was recorded for diastolic BP (DBP) — 17.6±3.2 mm Hg. (healthy athletes 8.7±1.3 mm Hg; $R<0.05$). In the daytime — up to 17.2±3.2 mm Hg. (healthy athletes 9.3±0.7 mm Hg; $R<0.01$). At night, systolic BP (SBP) variability reached 18.2±2.6 mm Hg. (healthy athletes 11.3±0.8 mm Hg; $R<0.05$), DBP variability was 16.3±3.5 mm Hg. (healthy athletes 8.3±0.8 mm Hg; $R<0.05$).

Diagnostic interest in the aspect of our study was the assessment of the interaction and stability of the response of functional systems in relation to

vet on physical activity. When performing a load on a bicycle ergometer, various types of reactions of CVS indicators were noted, which indicated various types of autonomic (autonomous) regulation disorders in response to motor activity.

Assessment of central hemodynamic parameters in the examined group showed a trend towards an increase in stroke volume compared to the corresponding indicator in healthy athletes (R<0.05). A decrease in the ratio of the increase in SBP to the increase in heart rate (HR) in athletes with SP to 0.280±0.038% (0.410±0.008%;R>0.05) characterizes a decrease in the autonomic balance in the regulation of cardiac activity. The increase in cardiac index at rest in the examined reached 4.1±0.2 l/min/m_2

(in the healthy group 3.2±0.3 l/min/m_2;R<0.05), which indicates low-economical work of the heart in athletes with SP.

The results of psychological testing using the POMS test indicated a decrease in resistance to psychological stress, manifested by a decrease in the background of mood, a significant increase in anxiety indicators (R<0.05), depression (R<0.05), fatigue (R<0.05), aggression (R<0.05) and a significant decrease in the strength-energy indicator (R<0.02).

Thus, in athletes with SP, violations of the functional state of the cardiovascular system were revealed: the predominance of the activity of the sympathetic nervous system with a decrease in the parameters of the parasympathetic component in the regulation of the heart rhythm and increased tension of the central circuit of its regulation. There was a redistribution of spectral characteristics towards the predominance of sympathetic activation, a decrease in the total power of the spectrum, hypertensive reactions to physical activity, a violation of the adaptive capabilities of the circulatory system, a decrease in resistance to psychological stress, mood, an increase in anxiety. and fatigue.

After the course of BRT, a positive dynamics of clinical symptoms was observed in the form of a decrease in headaches in 67% of athletes, in 60% there was a decrease in heart rate at rest. Manifestations of emotional lability, sleep disturbances decreased in 23% of cases. Patients subjectively noted an improvement in well-being, which was manifested by a decrease in emotional reactions to stress, normalization of sleep. In the control group, the absence of dynamics was noted by 87%, the improvement in the general condition was noted by 13% of the athletes.

HRV analysis data in athletes under the influence of BRT revealed an increase in RR by 10.9%: from 855.3±21.7 to 949.2±31.7 ms (R<0.05). SDNN value significantly increased from 37.1±14.2 to 142.1±38.2 ms (R<0.02), which indicates an increase in the autonomic regulation of the heart rate. An increase in the total power of the spectrum by 49% was revealed: from 2705±378 to 4033±252 ms_2(R<0.01), which characterizes the increase in the total activity of neurohumoral influences on the heart rate. Significantly, a large number of subjects showed an increase in parasympathetic activity: the contribution of HF increased (in absolute numbers from 487±142 to 1012±207 ms_2, which amounted to 107.8% (R<0.05), and in percentage from 12.5±1.5 to 39.5±3.8 (R<0.01)) in the total power of the spectrum, the autonomic balance index decreased from 2.75±0.52 to 0.92±0.08 arb. units (R<0.01). The value of the indicator of the percentage contribution of VLF in the group of athletes who received BRT became significantly lower - 26.8±5.5 arb. units (decreased by 46.5%;p<0.01). There was a significant decrease in the value of the LF index by 35.74%: from 73.3±2.5 to 47.1±1.8 nu (R<0.01,), 100% increase in HF value from 26.6±2.4 to 53.2±1.8 nu (R <0.01). A significant decrease in IC from 6.75±0.88 to 1.55±0.52 arb. units (R<0.01) and SI of regulatory systems from 141.1±31.8 to 50.6±16.2 arb. units (R <0.02) in the group where BRT was used, also indicates an increase in the activity of the autonomous regulatory circuit, a decrease in the tension of the central regulatory mechanisms and regulatory costs. The value of the variation range (Dx) significantly increased during the course of treatment from 307.4±71.1 to 724.3±208.0 ms_2(R<0.01). The above changes contributed to an increase in the efficiency of the body and the growth of adaptive reserves. In the control group, no significant dynamics of these indicators was revealed.

The positive dynamics of the clinical picture of the disease in athletes with initially elevated blood pressure values is confirmed by the positive dynamics of its daily monitoring indicators. Revealed a significant decrease in the average daily SBP in the daytime and at night. Daytime SBP variability decreased by 34% (R<0.02). With regard to the average daily indicators of BP variability, reliable data were obtained only for SBP (decrease in variability from 22.2±1.5 to 11.2±3.2 mm Hg; R<0.01). There was a significant decrease in the time index of hypertension (HTI) per day SBP from 43.1±3.5 to 25.2±2.6% (R<0.01), as well as during the day and night. Changes in IVH DBP in the daytime and at night were unreliable. A significant decrease in the rate of morning DBP rise by 41% was noted (R<0.05) and a significant increase in the morning SBP rise by 57.8% (R<0.05).

In the control group, there was a significant decrease in SBP per day (R<0.01) in the daytime (R <0.01) and night (R<0.01) time, as well as IVG SBP (R <0.01). Reliable dynamics of other indicators was not noted.

Dynamics of indicators of the psychological status of athletes with SP before and after BRT in comparison with the control (*M*±*m*)

Dynamics of characteristics of the psychological status of the athletes presenting with the overtraining syndrome before and after BRT in comparison with control (*M*±*m*)

Psychological indicator	2nd (control) group (*n*=30)		*R*	1st (main) group (*n*=30)		*R*
	before	after		before	after	
Tension-anxiety (5.66-9.6 points) Depression-depression (4.38-8.67 points) Anger-aggressiveness (6.24-9.91 points) Strength-energy (15.64-18.51 points) points) Fatigue-inertia (5.37-8.16 points) Uncertainty-confusion (4-7.38 points)	12.5±1.7	7.4±1.08	<0.05	11.8±1.2	6.7±1.5	<0.05
	9.87±0.75	8.2±1.1	> 0.1	10.09±1.05	8.4±2.5	> 0.1
	11.97±1.2	9.9±1.6	> 0.1	12.77±2.01	9.1±3.5	<0.05
	7.6±1.08	9.5±2.03	> 0.1	8.7±1.04	9.6±0.78	> 0.1
	11.54±1.5	6.9±1.9	<0.05	12.8±1.12	9.5±1.2	<0.05
	8.6±1.87	7.2±1.26	> 0.1	9.2±1.2	8.2±1.5	> 0.1

After BRT, economization of cardiac activity was noted: a decrease in heart rate at rest (R<0.05), its significant decrease by the standard load (R<0.01), decrease in the double product at rest from 106.6±4.2 to 93.5±3.2 arb. units (R<0.05). The ratio of the inochronotropic reserve became more optimal when performing a threshold load (ΔSBP%/ΔHR% increased from 0.282±0.035 to 0.462±0.011, R<0.01).

After the BRT course, positive dynamics in the psychological status of athletes was revealed. There was a statistically significant improvement in psychological indicators: fatigue, aggression, anxiety **(see table)**. Despite the obtained reliable changes in these indicators, they could not reach the normative levels of healthy athletes. In the control group, tension and fatigue significantly decreased, which can be associated with a decrease in the volume and intensity of the load in athletes

Thus, the use of BRT has a normalizing effect on HRV, causing an increase in the initially reduced power of the spectrum, reducing the intensity of the central circuit of heart rate regulation, and significantly increasing parasympathetic effects on heart rhythm; has a hypotensive effect on SBP, has a normalizing effect on BP variability in patients with initially increased BP variability, significantly reduces the time index of hypertension, and also has a normalizing effect on the circadian rhythm of BP and the rate of morning rise in DBP, has a positive effect on the psychological status of an athlete.

Adverse events

No adverse events were noted in the course of the study among the athletes who took part in this work.

Discussion

In numerous clinical studies conducted with the participation of athletes of various

In this category, data have been obtained indicating the role of disturbances in the neurogenic regulation of blood circulation, primarily an increase in the activity of the sympathetic nervous system, in the pathogenesis of SP, especially in the early stages of the formation of this pathological condition [15]. Activation of the sympathetic nervous system plays a role not only in increasing and maintaining blood pressure as one of the clinical symptoms of SP, but also acts as an independent risk factor for the development of complications, which contributes to a number of negative metabolic, trophic, and hemodynamic changes. nervous system and cardiovascular system in the body of both an active athlete and a highly qualified athlete in the past, and ultimately increases the risk of developing cardiovascular diseases and other pathological conditions.

Thus, in studies by foreign authors on the assessment of the prognostic significance of HRV, it was shown that low variability is significantly associated with the subsequent development of various types of arrhythmias [16]. In addition, when conducting a correlation analysis between the statistical indicators of the time analysis of HRV in athletes with SP and the presence of cardiac arrhythmias, a significant inverse relationship was found between a decrease in HRV and an increase in the incidence of SP development [17].

This imbalance contributes to an increase in heart rate in athletes with overtraining. Mechanisms that provoke an increase in heart rate also lead to an increase in cardiovascular risk. They include a tendency to arrhythmias, an increase in myocardial oxygen demand and a predisposition to ischemia with the subsequent development of such a formidable complication as sudden cardiac death in athletes during the training process. In addition, a number of clinical studies have demonstrated the effect on the development of endothelial dysfunction, which may result in early development of myocardial infarction in athletes at a younger age [18].

The use of classical methods of correction, both drug and non-drug, modulating the work of the cardiovascular system, namely the activity of the sympathetic

of the pathetic nervous system, can become both a pathogenetic and etiotropic method of correcting the state of overtraining, especially at the stage of its formation, when the increased activity of the sympathetic department of the nervous system is the main pathogenetic link.

Our results indicate a positive effect of BRT on the main clinical and functional manifestations of SP in athletes, which is carried out due to the normalization of HRV: a decrease in sympathetic activity, an increase in vagal influences (a decrease in LF/HF by 67%), a decrease in activity central regulation of heart rate (reduction of SI by 64.2%, CI by 77%), normalization of BP variability in 60% of athletes, moderate hypotensive effect (mainly in relation to SBP).

Our results generally confirm the data of other researchers [19–21], who showed high efficiency of BRT in improving autonomic homeostasis, hemodynamic parameters, psychological state, and behavioral reactions.

So, in the work of V.A. Sokolov [19] was the first to study the effect of a course of BRT on various clinical forms of neurocirculatory dystonia. The author notes the optimization of hemodynamic parameters, normalization of autonomic homeostasis, hemodynamic parameters, increase in physical abilities and improvement of the psycho-emotional state.

In the work of E.V. Kudinova [20] was the first to show that bioresonance corrective action normalizes the structural and functional state of neurons and interneuronal synapses of the hippocampus under stress, preventing the formation of pathological brain systems and stress-syndrome, in connection with which there is an improvement in the cognitive function of the brain and behavioral responses.

Research by L.V. Usacheva [21] proved that BRT promotes an increase in blood flow velocity, an increase in vasomotor reactivity.

The above studies determined our choice in favor of studying BRT as a method of pathogenetic therapy in athletes with SP. The results obtained by us confirmed our assumptions and proved the efficiency of using this method.

Conclusion

The results of the study indicate that the SP in the vast majority of athletes (about 90%) is accompanied by increased activity of the sympathetic nervous system, which dictates the need for the use of techniques aimed at correcting violations of this link of pathogenesis. The use of BRT can be considered as an adequate method for correcting SP in athletes with increased activity of the sympathetic nervous system. This study served as the basis for the development of a comprehensive program of rehabilitation treatment for athletes with SP with the simultaneous use of factors influencing the main links of pathogenesis in order to obtain the maximum effect and reduce the likelihood of complications.

Additional Information.

Conflict of interest. The authors declare no the effect of obvious and potential conflicts of interest associated with the publication of this article.

LITERATURE/REFERENCES

1. Volkov A.I., Razumov A.N., Bobrovnitsky I.P. Restorative medicine as a new direction in the science and practice of healthcare. In the book: *Diagnostic and wellness restorative medicine technologies*. M.2003. [Volkov AI, Razumov AN, Bobrovnitsky IP. Regenerative medicine as a new direction in the science and practice of health. In: *Diagnostic and health technologies of regenerative medicine*. M. 2003. (In Russ.)].
2. Petibois C, Cazorla G. Biochemical aspects of overtraining in endurance athletes. *Issues of sports medicine: foreign experience.* 2010;(1):3-10.
3. Susta D, Dudnik E, Glazachev OS. A program based on repeated hypoxia-hyperoxia exposure and light exercise enhances performance in athletes with overtraining syndrome: a pilot study. *Clin Physiol Funct Imaging*. 2017;37(3):276-261. https://doi.org/10.1111/cpf.12296
4. Gavrilova E.A. *Syndrome of overtraining. Contemporary problem state*. materialsVII international scientific-practical conference "Health for all". 2017;105. [Gavrilova EA. *Overtraining Syndrome. The current state of the problem*. Proceedings of the VII International scientific and practical conference "Health for all". 2017;105. (In Russ.)].
5. Decroix L, Piacentini M, Rietjens G, Meeusen R. Monitoring Physical and Cognitive Overload During a Training Camp in Professional Female Cyclists. *Int J Sports Physiol Perform*. 2016; 11(7):933-939.
6. Davidenko D.N. *The problem of restoring sports work abilities and functional reserves of the body. Reserve capabilities of the body of athletes*. Sat. scientific Art. Alma-Ata:; Kaz. Institute of Physics cult. 2005;30-33. [Davidenko D.N. *Problem of restoration of a sports raboto_sposobnost and functional reserves of an organism. Reserve opportunities of an organism of athletes*. Collection of scientific articles. Alma-Ata: Kazan institute of physical culture. 2005;30-33. (In Russ.)].
7. Yilmaz S, Calbiyik M, Yilmaz B, Aksoy E. Potential role of electrostimulation in augmentation of venous blood fow after total knee replacement: A pilot study. *Phlebology*. 2016;31(4):251-256. https://doi.org/10.1177/0268355515580473

8. Matveeva V.V., Vodolazov V.N. Efficiency of a combination of biofeedback devices and physiotherapeutic techniques in the rehabilitation treatment of people in dangerous professions.*Physitherapist*. 2010;2:6-7. [Matveeva VV, Divers VN. Efektivnost of a combination of ofces of biomanagement and physiotherapeutic techniques in recovery treatment of persons of dangerous professions.*Physiotherapist*. 2010;2:6-7. (In Russ.)].

9. Podberezkina L.A. Low-frequency complex modulated electrotherapy of patients with injuries of the capsular-ligamentous apparatus of the knee joint.*Physiotherapist*. 2006;2:19-23. [Podberezkina LA. Low-frequency complex modulated electrotherapy of patients with damages of the capsular and copular device of a knee joint. *Physiotherapist*. 2006;2:19-23. (In Russ.)].

10. Kiryanova V.V., Vorokhobina N.V., Makhramov Z.Kh. Study of the dynamics of the quality of life of patients with the use of bioresonance therapy in the complex treatment of hypothyroidism.*Bulletin of Avicenna*.2016;1:77-84. [Kiryanova VV, Vorokhobina NV, Makhramov ZH. Research of dynamics of quality of life of patients when using bioresonant therapy in complex treatment of a hypothyroidism.*Avicenna's Messenger*. 2016;1:77-84. (In Russ.)].

11. Sharina E.P., Tyutyukov V.G., Moskalionova N.A. Improving physical performance by BRT-therapy. *Problems of modern teacher education*. 2016;51-7:243-250. [Sharina EP, Tyutyukov VG, Moskalyonova NA. Increase in physical working capacity by the BRT-therapy method. *Problems of Modern Pedagogical Education*.2016;51-7:243-250. (In Russ.)].

12. Mohamed Ali V.Kh., Bokeria O.L., Salia N.T., Kuular A.M., Glushko L.A., Le T.G., Bazarsadaeva T.S., Gotovsky M.Yu. Evaluation of the influence of low-intensity electromagnetic fields on the state of the microvasculature in the area of the postoperative wound in cardiosurgical patients.*Bul- leten NTSSSH them. A.N. Bakuleva RAMS. Cardiovascular diseases.* 2012;53:126. [Mohamed Ali VH, Bokeria OL, Saliya NT, Kuular AM, Glushko LA, Le TG, Bazarsadayeva TS, Gotovsky MYu. Assessment of infuence of low-intensive electromagnetic felds on a condition of the microcirculator course in the feld of a postoperative wound at cardiac patients.*Bulletin NTsSSH of AN Bakulev of the Russian Academy of Medical Science. Cardiovascular diseases.*2012:53:126. (In Russ.)].

13. Bokeria L.A., Bokeria O.L., Saliya N.T., Dzidziguri D.V. Gotovsky M.Yu., Mohamed Ali V.Kh., Bakuradze E.D., Modebadze I.R. Influence of endogenous bioresonance therapy on changes in blood levels of biomarkers of acute myocardial infarction in the experiment.*Bulletin of the NCSSH them. A.N. Baku-left RAMN. Cardiovascular diseases.*2011;3:38-43. [Bokeria LA, Bokeria OL, Saliya NT, Dzidziguri DV, Gotovsky MYu, Mohamed Ali VH, Bakuradze ED, Modebadze IR. Infuence of endogenous bioresonant therapy on change of content in blood of biomarkers of a sharp myocardial infarction in an experiment.*Bulletin NTsSSH of AN Bakulev of the Russian Academy of Medical Science. Cardiovascular diseases.*2011;3:38-43. (In Russ.)].

14. Vakhitov I.Kh., Martyanov O.P., Pavlov S.N., Miskhabov A.A. Changes in the pumping function of the heart of children during systematic sports.*Russian Physiological Journal them. THEM. Sechenov*. 2004;90:8:213. [Vakhitov IH, Martyanov OP, Pavlov SN, Miskhabov AA. Change of pump function of heart of children at systematic sports activities.*The Russian physiological magazine of IM Sechenov.*2004;90(8):213. (In Russ.)].

15. Didur M.D., Gurevich T.S., Matveev S.V. Prognostic value of myocardial hypertrophy in athletes of high sports qualifications.*Therapeutic physical culture and massage.* 2010;12:25-33. [Didur MD, Gurevich TS, Matveev SV. Prognostic value of myocardial hypertrophy in athletes of high qualifcation.*Medical Physical Culture and Massage.* 2010;12:25-33. (In Russ.)].

16. Hynynen E. Heart rate variability during night sleep and after awakening in overtrained athletes. *Med Sci Sports Exerc*. 2006;38(2): 313-317.

17. Pichot V. Relationship between heart rate variability and training load in middle-distance runners.*Med Sci Sports Exerc.*2000;32(10): 1729-1736.

18. Mironova S.P.*Sports medicine.*M. 2013. [Mironova SP. *sports medicine.*M. 2013. (In Russ.)].

19. Sokolov AB Diagnostic technologies of restorative medicine: achieved results and development prospects.*Bulletin of restorative medicine.*2008;5(27):4-9. [Sokolov AB. Diagnostic technologies of restorative medicine: achieved results and prospects of development.*Bulletin of Restorative Medicine*. 2008;5(27):4-9. (In Russ.)].

20. Kudinova E.V.*Structural and functional changes in hippos camp in stress syndrome and their correction by bioresonance therapy:* Dis. ... cand. honey. Sciences. Tyumen.2004. [Kudinova EV. *Structural and functional changes of the hippocampus in stress syndrome and their correction by bioresonance therapy.*Aabstract. Tyumen. 2004. (In Russ.)].

21. Usacheva L.V.*Biological effects of bioresonance therapy in rehabilitation treatment for cervical osteochondrosis:*Dis. . . . cand. honey. Sciences. M. 2002. [Usacheva LV.*Biological effects of bioresonance therapy in the recovery treatment of cervical osteochondrosis.*Aabstract. M. 2002. (In Russ.)].

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