UDC 61:796:577.3

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DOI 10.32782/2522-9680-2023-3-73

To cite this article: Filiunova O., Nevoit G., Potyazenko M., Vainoras A. (2023). Bioelektronna medytsyna u sporti: obgruntuvannia biofizychnykh mekhanizmiv ta klinichnoi dotsilnosti vykorystannia [Bioelectronic medicine for sports: justification of biophysical mechanisms and clinical feasibility of use]. *Fitoterapiia. Chasopys – Phytotherapy. Journal,* 3, 73–82, doi: 10.32782/2522-9680-2023-3-73

BIOELECTRONIC MEDICINE FOR SPORTS: JUSTIFICATION OF BIOPHYSICAL MECHANISMS AND CLINICAL FEASIBILITY OF USE

Actuality. *The search for effective methods capable of normalizing and optimizing metabolic processes at the tissue level in athletes to maintain their health and high performance remains relevant. Bioelectronic medicine is at the forefront of a potential revolution in the treatment of diseases and is a promising direction of scientific research, it is one of the most promising and effective directions of therapeutic correction of metabolism in tissues in vivo in athletes, it is the result of innovative discoveries of mechanisms of neural control of biological processes of disease pathogenesis and development of devices to modulate these specific neural circuits as electron therapy instead of drugs.*

The purpose *of this theoretical study was to conceptualize a system of biophysical fundamental scientific views regarding the possibilities of applying bioelectronic medicine, namely bioresonance therapy in sports.*

Material and methods. *General scientific methods and theoretical methods were used in this theoretical study.*

Research results. *This theoretical study extrapolated the concepts of the magnetoelectrochemical theory of metabolism and the existing fundamental knowledge about the role of electromagnetic processes in the human body to substantiate the possibilities of applying the methods of bioelectronic medicine, in particular, bioresonance therapy in sports. Substantial descriptions of the basic ideas about the frequency-wave biophysical model of the human body structure and the presence of specific frequency characteristics in hertz in each type of molecules, cells, tissues, organs and processes were developed. The diagnostic and therapeutic possibilities of using bioelectronic medicine, namely bioresonance therapy in sports, were postulated.*

Conclusion. *The theoretical basis for justifying the use of bioelectronic medicine in sports is modern fundamental biophysical knowledge about the structure of tissues of the human body at the nanolevel of their structural organization, the magnetoelectrochemical theory of metabolism, the frequency-wave-wave biophysical model of the structure of the human body and the presence of each type of molecules, cells, tissues, organs and processes of specific frequency characteristics in hertz. The diagnostic capabilities of bioelectronic medicine in sports, namely bioresonance therapy, are the ability to perform an objective instrumental assessment of the following parameters: 1) parameters of the functioning of organs and organ systems according to the correspondence of their frequencies to normal indicators with verification of pathological deviations even at the preclinical stage; 2) to verification of existing components of the microbiome, pathological agents and processes with determination of their approximate localization in organs or parts of the body; 3) the assessment of the quality of individual nutrition of each athlete with verification of his nutritional deficiencies, selection of necessary nutrients and, if necessary, individual selection of necessary pharmacological drugs; 4) the assessment of individual characteristics of the athlete's current psycho-emotional state. The diagnostic capabilities of bioelectronic medicine in sports, namely*

bioresonance therapy, are the ability to perform: 1) the correction/optimization of the functioning of organs and organ systems with frequency leveling of pathological processes at the preclinical stage; 2) the correction of the microbiome with the destruction of pathological agents; 3) the optimization of lymphatic drainage and repair in the musculoskeletal system; 4) therapeutic effect on the psycho-emotional state of athletes. Bioelectronic medicine and, in particular, methods of bioresonance therapy are a promising and appropriate medical direction for use in sports.

Key words: *bioelectronic medicine, magneto-electrochemical theory of metabolism, bioresonance therapy, electromagnetic field, health, sports medicine.*

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DOI 10.32782/2522-9680-2023-3-73

Бібліографічний опис статті: Філюнова О., Невойт Г., Потяженко М., Вайнорас А. (2023). Біоелектронна медицина у спорті: обґрунтування біофізичних механізмів та клінічної доцільності використання. *Фітотерапія. Часопис,* 3, 73–82, doi: 10.32782/2522-9680-2023-3-73

БІОЕЛЕКТРОННА МЕДИЦИНА У СПОРТІ: ОБҐРУНТУВАННЯ БІОФІЗИЧНИХ МЕХАНІЗМІВ ТА КЛІНІЧНОЇ ДОЦІЛЬНОСТІ ВИКОРИСТАННЯ

Актуальність. *Пошук ефективних методик, які здатні нормалізувати та оптимізувати метаболічні процеси на тканинному рівні у спортсменів для підтримки їх здоров'я та високої результативності, залишається актуальним. Біоелектронна медицина знаходиться на передньому краї потенційної революції у лікуванні захворювань та є перспективним напрямом наукових досліджень, одним із найбільш перспективних та дієвих напрямів терапевтичної корекції метаболізму у тканинах in vivo у спортсменів, це результат новаторських відкриттів механізмів нейронного контролю біологічних процесів патогенезу захворювань та розроблення пристроїв для модуляції цих специфічних нейронних ланцюгів як терапії за допомогою електронів замість ліків.*

Мета дослідження *– концептуалізувати систему біофізичних фундаментальних наукових поглядів стосовно можливостей застосування біоелектронної медицини, а саме біорезонансної терапії у спорті.*

Матеріал і методи*. Під час виконання теоретичного дослідження були використані загальнонаукові і теоретичні методи.*

Результати дослідження*. Це теоретичне дослідження екстраполювало концепти магнітоелектрохімічної теорії обміну речовин і наявні фундаментальні знання стосовно ролі електромагнітних процесів в організмі людини на обґрунтування можливостей застосування методик біоелектронної медицини, зокрема біорезонансної терапії у спорті. Розроблено обґрунтовані описи базових уявлень про частотно-хвильову біофізичну модель структури тіла людини та наявність у кожного типу молекул, клітин, тканин, органів і процесів специфічних частотних характеристик у герцах. Постульовано діагностичні і терапевтичні можливості застосування біоелектронної медицини, а саме біорезонансної терапії у спорті.*

Висновок. *Теоретичним підґрунтям обґрунтування застосування біоелектронної медицини у спорті є сучасні фундаментальні біофізичні знання про будову тканин людського тіла на нанорівні їх структурної організації, магнітоелектрохімічна теорія обміну речовин, частотно-хвильова біофізична модель структури тіла людини та наявність у кожного типу молекул,*

клітин, тканин, органів і процесів специфічних частотних характеристик у герцах. Діагностичні можливості біоелектронної медицини у спорті, а саме біорезонансної терапії, полягають у можливості здійснювати об'єктивну інструментальну оцінку таких параметрів: 1) функціонування органів і систем органів за відповідністю їх частот показникам норми з верифікацією патологічних відхилень ще на доклінічному етапі; 2) наявних компонентів мікробіому з верифікацією патологічних агентів і процесів із визначенням їх орієнтовної локалізації в органах або частинах тіла; 3) оцінку якості індивідуального харчування кожного спортсмена з верифікацією його харчових дефіцитів, підбором необхідних йому нутрієнтів та за необхідності виконувати індивідуальний підбір необхідних фармакологічних препаратів; 4) індивідуальних особливостей поточного психоемоційного стану спортсмена. Діагностичні можливості біоелектронної медицини у спорті, а саме біорезонансної терапії, полягають у можливості здійснювати: 1) корекцію/оптимізацію функціонування органів і систем органів із частотним нівелюванням патологічних процесів на доклінічному етапі; 2) корекцію мікробіому зі знищенням патологічних агентів; 3) оптимізацію лімфодренажу та репарації у м'язовій, кістково-суглобовій системах; 4) терапевтичну роботу із психоемоційним станом спортсменів. Біоелектронна медицина і зокрема методики біорезонансної терапії є перспективним і доцільним медичним напрямом для застосування у спорті.

Ключові слова: *біоелектронна медицина, магнітоелектрохімічна теорія обміну речовин, біорезонансна терапія, електромагнітне поле, здоров'я, спортивна медицина.*

Introduction. It is well known that a certain crisis is emerging in professional sports due to the fact that the adaptation capabilities of the athletes' bodies have reached certain limits. At the same time, a high-intensity training process, pronounced physical and psycho-emotional stress, insufficient medical control over the state of the functional systems of the athlete's body, over the adequacy of its recovery, limited possibilities for using pharmacological agents during the recovery process, shortened courses of treatment for emerging ailments, seasonal colds, and the presence of foci of chronic infection can lead to a systematic gradual decrease in the level of health of athletes and reduce functional reserves their body. As a consequence, this may cause a decrease in sports performance. This explains the relevance of the search for effective methods that can normalize and optimize metabolic processes at the tissue level in athletes to support their health and high performance.

In this aspect, bioelectronic medicine continues to be one of the most promising and effective areas of therapeutic correction of metabolism in tissues in vivo in athletes. At the same time, scientific interest in the methods of bioresonance therapy should now increase. This is so, since at the present stage there is a significant scientific breakthrough in understanding the role of electromagnetic processes in ensuring the phenomenon of life, intercellular signaling and metabolism in the cells of living organisms - the transition from the electrochemical paradigm of metabolism to the magnetoelectrochemical paradigm (Boyko, 2003; Boyko, 2022; Gulyar, 2022; Kolbun, 2022; Mintser, et al., 2019; Mintser, et al., 2020; Mintser, et al., 2021; Mintser, et al., 2023; Nevoit, 2021; Nevoit, et al., 2023). Also, at present, computerization and technological progress have led to a significant qualitative breakthrough in the technical capabilities, convenience, accessibility and variety of certified medical equipment for bioelectronic therapy. Bioelectronic medicine is the result of combining molecular medicine, neurobiology, engineering and computer science to develop devices for diagnosing and treating diseases. Bioelectronic medicine is the result of pioneering discoveries of mechanisms for neural control of biological processes that underlie disease, and the development of devices to modulate these specific neural circuits as therapy using electrons instead of drugs. Bioelectronic medicine is at the forefront of a potential revolution in the treatment of diseases and is a promising area of scientific research (Datta-Chaudhuri et al., 2021; Ezeokafor et al., 2021; Ganzer, Sharma, 2019; Gibney et al., 2021; Olofsson et al., 2017; Sanjuan-Alberte et al., 2018; Singh et al., 2022; Sevcencu, 2022).

This is all so, because the science of the 21st century has advanced significantly and crossed the global rubicon understanding the microlevel organization of substance. Awareness of the fact that at levels above 10^{-14} nm matter has an electromagnetic structure and consists of electromagnetic field structures, fundamentally changes the scientific view of living biological systems, including the human body. This opens up to medical science fundamentally different horizons of studying and understanding the processes of the structure and functioning of the human body. Just as the appearance of the microscope once became the basis of a scientific breakthrough, so now the latest knowledge of quantum physics has become the foundation for the formation of an improved paradigm of ideas about the living tissues of the human body (Mintser et al., 2019, 2020, 2021, 2023; Nevoit, 2021; Nevoit et al., 2023). This fundamental knowledge has worldwide recognition and should continue its integration into medical sciences, in particular sports medicine.

That is why the purpose of this theoretical study was to conceptualize a system of biophysical fundamental scientific views regarding the possibilities of applying bioelectronic medicine, namely bioresonance therapy in sports.

Materials and methods. Scientific work a fragment of research work of the Department of Internal

Medicine and Emergency Medicine of Poltava State Medical University (23, Shevchenko str., Poltava, 36011, Ukraine) on "Development of algorithms and technologies for implementing a healthy lifestyle in patients with Non-Communicable Diseases (NCDs) based on the study of functional status" (state registration number 0121U108237).

Scientific work is carried out in conjunction with the following scientific institutions: 1) Poltava State Medical University (23, Shevchenko str., Poltava, 36011, Ukraine), the cooperation coordinator is the Head of the Department of Internal Medicine and Emergency Medicine, prof., DM M.M. Potiazhenko; 2) Lithuanian University of Health Sciences (9, A. Mickevičius str., Kaunas, LT-44307, Lithuania), the cooperation coordinator is the Head of Nephrology Department, prof., DM I. A. Bumblyte. Doctor O. Filyunova took part in the research as an initiative researcher-applicant.

General scientific methods (dismemberment and integration of elements of the studied system, imaginary experiment, logical, historical research, analysis, induction, deduction, and synthesis of knowledge) and theoretical methods (method of constructing theory, logical methods, and rules of normative nature) were used in this theoretical study.

Research results. A systematic medical analysis and generalization of modern views on the biophysical justification of the possibilities of bioelectronic medicine in sports has been carried out. A fundamental conclusion was made that the principles of the therapeutic possibilities of bioelectronic medicine, namely bioresonance therapy techniques, are based on the principles of the structural structure of matter at the subatomic and atomic levels. At the same time, a scientific conclusion was reached that the specified fundamental conclusion stems from such new concepts for orthodox medicine (but not for fundamental science) as the frequency-wave biophysical model of the structure of the human body and the proven fact of the presence of specific frequency characteristics in hertz (Hz) for each type molecules, cells, tissues, organs and metabolic processes in the human body.

The following simplified explanatory descriptions of these basic concepts were developed to further integrate the ideas into systemic and sports medicine:

1. The frequency-wave biophysical model of the human body structure is a basic concept for understanding and describing the functioning of living cells in vivo at the nanolevel and deeper (10^{-45}nm) of their structural organization.

Rationale: All matter of the planet Earth and the human body consist of about 100 types of atoms. All atoms, regardless of the type of atom, consist of a nucleus, an electron shell and are divided, have a corpuscular-wave electromagnetic essence of organization – that is, they have the properties of both particles and waves at the same time. At the same time, the nucleus of an atom consists of field structures – fermions, which are united by the fundamental field forces of electromagnetic, strong, and weak nuclear interactions, the carriers of which are bosons – accordingly, all particles of an atom are different forms of energy. In total, the energies forming the atoms cause the corresponding electric charges of the atoms. This determines the exchange interaction of electrons between atoms, the primary properties of atoms and the objects formed by them (molecules, etc.) at the macro level of the world – accordingly, all chemical reactions are the result of the exchange interaction of electrons between atoms, and chemical reactivity in general is a secondary property that is determined by the electromagnetic characteristics of atoms. Thus, according to modern scientific views, the human body has an electromagnetic field structure at the subatomic and atomic levels. Therefore, the human body can be considered at the micro level of its structure as a form of fundamentally organized energy that has the total energy characteristics of the particles of the microcosm that make them up (quarks, antiquarks; fermions and bosons; neutrons, protons, electrons; atoms, molecules, etc.). And accordingly, the human body can be described in a model that will allow to characterize the specificity of energy properties of its tissues, organs and metabolic processes in them. The frequency-wave biophysical model of the human body structure corresponds to this description. The frequency-wave biophysical model of the human body structure corresponds to this description (Mintser et al., 2021; Mintser et al., 2023; Nevoit, 2021; Nevoit et al., 2023).

2. Each type of molecules, cells, tissues, organs and processes has its own specific frequency characteristics in hertz (Hz), and this corresponds to the frequency-wave model of the structure of the human body.

Rationale: The bodies of all living organisms and humans are made of atoms. The nucleus of each atom has a charge and is constantly rotating. Each type of atom, substance is characterized by its own specific constant frequency of rotation – the precession of the nucleus. If the frequency of nuclear precession is known, then it is possible to determine the composition of the human body, the presence of certain substances, types of cells and tissues, and processes in it. According to modern scientific approaches, the precession of atomic nuclei can be established as follows: it is necessary to irradiate atomic nuclei with radio waves, constantly changing the frequency until it coincides with the frequency

of nuclear precession – at the same time, a resonance will occur, which will be recorded by a measuring device. This principle made it possible to scientifically establish the frequency characteristics of most known microorganisms, chemical substances, tissues and processes of functioning of organs of the human body. It is also widely used for intravital study of the structural organization of the human body – the method of nuclear magnetic resonance. In 1952, Felix Bloch and Edward Purcell (USA) received the Nobel Prize in Physics for the discovery of the phenomenon of nuclear magnetic resonance. In 2003, Paul Lauterbur (USA) and Peter Mansfield (Great Britain) received the Nobel Prize in Physiology and Medicine for the development of the diagnostic method of magnetic resonance imaging. Thus, according to modern scientific views, substances (trace elements, vitamins, hormones, etc.), types of cells and tissues (microorganisms, cancer cells, etc.), metabolic processes in the human body can be verified by the total frequency component of their own metabolic processes according to with the help of special diagnostic equipment that allows you to fix the phenomenon of resonance (Koutcher, Burt, 1984; Mintser et al., 2021; Potyazhenko, Nevoit, 2019).

On the basis of the theoretical research indicated during the performance of the diagnostic possibilities of the use of bioresonance therapy in sports, the following was postulated:

1. To carry out an objective instrumental assessment of the functioning of organs and organ systems based on the correspondence of their frequencies to normal indicators with the verification of pathological deviations even at the preclinical stage (premorbid diagnosis).

Rationale: It follows from these basic concepts that each healthy tissue and each healthy organ is characterized by a set of natural frequencies of their normal functioning. These frequency components are of fundamental physiological importance, as they are a component of intercellular signaling and electromagnetic communication between tissues *in vivo* (Levin et al., 2017, 2021; Levin, 2014, 2021; Nevoit et al., 2023). When pathological conditions occur, a deviation from the frequency spectrum is noted. This can be fixed with the help of equipment for bioresonance therapy at the preclinical stage of pathology (Sylver, 2011; Vértesi, 2024, 2010).

2. To carry out an objective instrumental assessment of the microbiome with the verification of pathological agents and processes with the determination of their approximate localization in organs or parts of the body.

Rationale: It is common knowledge that the human body consists of 30 trillion cells. At the same time, the human body contains 40–50 trillion cells of other microorganisms, which do not belong to the human body itself and are called the microbiome. It is now proven that the composition of the microbiome determines the key processes of the human body: from the processes of digestion and assimilation of food to complex immune responses and the impact on the higher nervous activity of a person (Ursell et al., 2012; Rackaityte, Lynch, 2020). Therefore, having a "healthy" microbiome is very important for athletes. The presence of chronic untreated foci of infection, excess bacterial overload, changes in the quality of the microbiome, the presence of chronic persistence of viruses, intracellular parasites, excess fungal flora, etc., can cause a general load on the athlete's body, reducing the metabolic potential of both individual organs and the body as a whole. Technical possibilities are now available for verification of pathogenetic components of the microbiome with the help of bioelectronic medicine equipment, since the frequency characteristics of most microorganisms are now known and professional databases/selectors (for example The Consolidated Annotated Frequency List – CAFL, The Non-Consolidated Frequency List – NCFL, The All-Frequencies CAFL (AFCAFL), etc.) have been created (Sylver, 2011; Vértesi, 2024, 2010).

3. To carry out an objective instrumental assessment of the quality of the individual nutrition of each athlete with the verification of his nutritional deficiencies, the selection of the nutrients he needs, and the individual selection of the necessary pharmacological drugs for each athlete in accordance with his own frequency-wave spectrum of body composition, if necessary.

Rationale: Everything around us has its own frequency characteristics, since the entire material world is made of atoms. This idea extends to both food and pharmacological drugs. Currently, databases of frequency characteristics of food products and a significant number of medicines have also been developed and exist. Accordingly, there is a technical possibility with the help of equipment for bioresonance therapy to diagnose nutritional deficiencies (vitamin, amino acid, mineral, etc.) in the athlete's menu, to perform a professional selection of his nutrition according to the features of the frequency-wave response of his body. Bioresonance drug testing can help select the most effective pharmacological agent or combination from available analogues of various pharmaceutical manufacturers for a specific athlete in accordance with the characteristics of his metabolism. All this opens up significant prospects for further optimization of the life and health level of the athlete on the way to the growth of his physical capabilities (Islamov et al., 2004; Sylver, 2011; Vértesi, 2024, 2010).

4. To carry out an objective instrumental assessment of the individual characteristics of the athlete's current psycho-emotional state.

Rationale: The brain is the organ whose frequency components of functioning are the most studied. Brain neurons respond in unison to stimuli, creating rhythms of brain wave activity. The electrical activity of the brain was studied by electroencephalography. The magnetic activity of the brain was studied by magnetoelectrography. The following rhythms are distinguished depending on the frequency of brain activity: Beta (13 to 100 Hz), Alpha (8 to 12.9 Hz), Theta (4 to 7.9 Hz) and Delta (0.1 to 3.9 Hz). Each of these rhythms is a special type of cortical activity and correlates with different states of consciousness, such as anxiety, rest, sleep, etc. The human brain constantly produces different amounts of all these frequencies at the same time, depending on the psycho-emotional state of the person. Therefore, our state of consciousness reflects the mixed activity of the rhythms of different waves of brain activity and its localization (Buzsaki, 2011; Buzsáki, Watson, 2012; Basar, Bullock, 2012; Gross, 2019). According to certain frequency characteristics, the current emotional state of a person can be diagnosed if an examination is carried out on bioresonance therapy devices (Brugemann, 1993; Dörfler, 2002; Kirsever, 2022; Will, 2003; Wild, 2009).

In the course of conducting a theoretical study regarding the therapeutic possibilities of using bioresonance therapy in sports, the following was postulated:

1. To carry out corrections/optimization of the functioning of organs and organ systems with frequency leveling of pathological processes at the preclinical stage.

Rationale: According to the magnetoelectrochemical theory of metabolism, the pathological process begins to appear with a change in the electromagnetic characteristics of atoms and their components under the influence of pathogenetic factors. As a result, the total electromagnetic characteristics of molecules, substances, and subsequently cells and tissues change. This leads to the appearance of other electromagnetic signaling. Chemical reactions at the level of cells begin to occur differently as well, since chemistry is a secondary phenomenon of electromagnetism. These electromagnetic-chemical shifts can grow and accumulate over a long period of time and eventually manifest as predictors of chronic non-communicable diseases, and then they can turn into disease (Mintser et al., 2021). But the frequency-wave method of diagnosis can identify pathological processes at the preclinical stage. After diagnosis, it is possible to carry out frequency correction with resonant frequencies according to two mutually complementary types of therapeutic influence: passive therapy and active therapy (Brugemann, 1993; Dörfler, 2002; Kirsever, 2022; Malmivuo, Plonsey, 1995; Sylver, 2011; Vértesi, 2024, 2010; Wild, 2009; Will, 2003).

The principle of passive therapy is that the signal taken from the body is reflected and returned to the body in an inverted state. At the same time, pathological frequencies are suppressed by this "inverted" signal. This gradually eliminates the pathogenetic frequency component from the cellular electromagnetic signaling and promotes the restoration of normal communication between the cells of the organ. This gradually normalizes its functional activity. The principle of active therapy is that the device of bioresonance therapy actively provides the body with the normal frequency of the organ's work, gradually, as it were, "imposing" it. It also contributes to the normalization of the functioning of the organ by actively supplying the necessary frequencies of intercellular electromagnetic signaling (Malmivuo, Plonsey, 1995; Dörfler, 2002; Kirsever, 2022; Will, 2003).

2. To correct the microbiome with the destruction of pathological agents.

Rationale: The destruction of pathogenic microorganisms occurs thanks to the universal law of the universe – the law of resonance interaction. If the frequency of a microbial agent (virus, bacteria, fungi, protozoa) is known, then the transfer of this frequency to the human body will cause resonant oscillatory changes in the morphological structures of these microorganisms, if they are present in the human body.

The transmission of this frequency does not affect human tissues and other microorganisms, since it is specific for a certain pathogen or pathogens, and this will subsequently lead to their physical destruction and, accordingly, death (Clark, 2011; Dörfler, 2002; Kirsever, 2022; Will, 2003; Dartsch, Heimes, 2022; Sylver, 2011; Vértesi, 2004).

3. To optimize lymphatic drainage and repairs in the muscular, bone and joint system.

Rationale: It has been proven that stimulation with a low-frequency electric current with a frequency of about 2 Hz with a specific form of electric pulses causes natural peristalsis and contraction of the smooth muscles of venous and lymphatic vessels. This contributes to the improvement of venous and lymphatic outflow. It enhances the processes of cellular metabolism, stimulates arterial blood circulation, promotes the removal of excess fluid from tissues due to intercellular drainage, reduces muscle-tonic syndrome, improves microcirculation and reduces congestion in tissues, exerts an anti-

inflammatory effect, stimulates reparative processes (wound healing, resorption of hematomas) (Dörfler, 2002; Kirsever, 2022; Will, 2003). These techniques are effective in the treatment of the musculoskeletal system (Abdulla et al., 2019; Alzayed, Alsaadi, 2020; Arneja et al., 2016; Barassi et al., 2020; Kanashiro et al., 2018; Marcia, Saba, 2017; Trofè et al., 2023; Page et al., 2014), which is of fundamental importance for sports medicine.

4. To carry out a therapeutic effect on the psycho-emotional state of athletes.

Rationale: A psycho-emotional state is the result of wave electromagnetic activity of the brain. Therefore, if necessary, it can be corrected or optimized using bioresonance therapy techniques. Conducting passive bioresonance therapy with the delivery of the patient's own inverted signal allows influencing the pathological wave processes of brain activity, reducing them. Active bioresonance therapy makes it possible to modulate the activity of physiological rhythms of brain activity due to induction programs, it imposes the necessary frequency components on the wave processes of neuronal activity (Dörfler, 2002; Kirsever, 2022; Will, 2003). The clinical effectiveness of these methods has been proven and is used for the treatment of mental disorders in medical practice (Muresan et al., 2021, 2022; Won et al., 2020). Therefore, it is advisable to use certified medical devices of bioresonance therapy in health work with athletes, since their physical achievements and victories are directly related to their psycho-emotional setting (Kuettel, Larsen, 2019; Åkesdotter et al., 2022; Walton et al., 2023).

Discussion

In recent decades, many physicians note in specialized publications that the development of technologies continues to change the world and that bioelectronic medicine is at the forefront of revolutionary transformations in the medical field (Mintser et al., 2021; Olofsson, Tracey, 2017). According to numerous scientists, the emergence of a significant amount of fundamentally new paradigm-transforming fundamental knowledge regarding the organization and functioning of matter at the nanolevel should arouse significant interest among doctors and transform the views of modern medicine towards the magnetoelectrochemical theory of metabolism (Mintser et al., 2021; Boyko, Krasnogolovets, 2004; Boyko, 2022; Kolbun, 2022; Gulyar, 2022). This will enable doctors to move to a deeper level of fundamental ideas about the functioning of the human body. All scientists will then understand that it is electromagnetic processes that control molecules and make these molecules and biological tissues alive. This will enable them to carry out the prevention of diseases in a scientifically based and conscious manner using fundamentally new approaches of applying the methods of bioelectronic medicine. According to our team of authors and a number of scientists, correction of the functioning of body organs and systems with the help of various types of electromagnetic energy (photons, electrons, etc.) with the corresponding frequency-wave properties can very effectively supplement the existing therapeutic and preventive methods in sports medicine and ensure its progress. It is the progress in the field of bioelectronic medicine and the latest understanding of the biophysical mechanisms of tissue functioning at the micro level of their structure from the standpoint of the magneto-electrochemical theory of metabolism that allow us to look at the phenomenon of human health in a different way. It is important to note that based on the positions of the magnetoelectrochemical theory, the phenomena of life and health acquire new characteristics of their conceptual apparatus. This is so, because they should be described now and as a state of having adequate (which will be specified in the future) levels of magnetoelectric energy processes between biomolecules. This is objectively manifested at the macro level by the normal level of metabolism, functioning of tissues and organs of the human body. Accordingly, the life of a biological system is a process of magnetoelectric activation of its biomolecules, which triggers and ensures their biochemical activity and ensures the structural integrity of the collective interaction of the molecules of a whole organism. It is logical to consider the disease as a violation of the magnetoelectric state of biomolecular structures. Death is characterized by the complete absence of processes of electromagnetic activation of biomolecules (Mintser et al., 2021; Nevoit, 2021; Nevoit et al., 2023). The above provides an understanding that the human body is one of the forms of magneto-electrochemical organization of biological matter on Earth. Accordingly, if the human body is electromagnetic energy and is controlled by electromagnetic energy, then it is only logical that external electromagnetic influences on the human body have clinical effects. Thus, in accordance with the ideas and methods of bioelectronic medicine, it makes it possible to actively work with functionally healthy people and professional athletes, to provide them with disease prevention and to increase their level of health. Therefore, in our opinion, most of the technologies of bioelectronic medicine and, first of all, the methods of bioresonance therapy should arouse great interest among doctors of sports medicine. Therefore, it is necessary to actively draw the attention of the medical scientific community to them. The winning is the main goal of professional sports. According to numerous authors, victory in competitions depends on the psycho-emotional state and mental preparation of the athlete for

the competition. The correction of emotional disorders in athletes is also very important (Åkesdotter et al., 2022; Zhdan et al., 2011; Kuettel, Larsen, 2019; Walton, 2023). Psychoemotional state is usually an individual parameter that cannot be artificially created by pharmacological agents. Therefore, the wide application of bioelectronic medicine techniques, namely induction programs of bioresonance therapy, is an invariant and quite promising means of adequate mental preparation for competitions.

The ideas and concepts of bioelectronic medicine do not contradict the existing scientific knowledge of medical science. On the contrary, they are the next scientific addition to the currently available paradigm and allow us to master and theorize the phenomena and processes of the functioning of the human body even more deeply than histology and histochemistry. A number of famous Ukrainian scientists have already given a positive assessment of this scientific direction and noted the value of the magnetoelectrochemical theory of metabolism (Boyko, 2022; Kolbun, 2022; Gulyar, 2022).

Conclusions. The theoretical basis for justifying the use of bioelectronic medicine in sports is modern fundamental biophysical knowledge about the structure of tissues of the human body at the nanolevel of their structural organization, the magnetoelectrochemical theory of metabolism, the frequency-wave-wave biophysical model of the structure of the human body and the presence of each type of molecules, cells, tissues, organs and processes of specific frequency characteristics in hertz.

The diagnostic capabilities of bioelectronic medicine in sports, namely bioresonance therapy, are the ability to perform an objective instrumental assessment of the following parameters:

1) parameters of the functioning of organs and organ systems according to the correspondence of their frequencies to normal indicators with verification of pathological deviations even at the preclinical stage;

2) to verification of existing components of the microbiome, pathological agents and processes with determination of their approximate localization in organs or parts of the body;

3) the assessment of the quality of individual nutrition of each athlete with verification of his nutritional deficiencies, selection of necessary nutrients and, if necessary, individual selection of necessary pharmacological drugs;

4) the assessment of individual characteristics of the athlete's current psycho-emotional state.

The diagnostic capabilities of bioelectronic medicine in sports, namely bioresonance therapy, are the ability to perform: 1) the correction/optimization of the functioning of organs and organ systems with frequency leveling of pathological processes at the preclinical stage; 2) the correction of the microbiome with the destruction of pathological agents; 3) the optimization of lymphatic drainage and repair in the musculoskeletal system; 4) therapeutic effect on the psycho-emotional state of athletes.

Bioelectronic medicine and, in particular, methods of bioresonance therapy are a promising and appropriate medical direction for use in sports.

Perspectives of further research. Theoretical research on the extrapolation of the ideas of the magneto-electrochemical theory of metabolism to justify the possibilities of applying the methods of bioelectronic medicine in various medical fields continues.

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Стаття надійшла до редакції 15.05.2023
Стаття прийнята до друку 24.07.2023

Конфлікт інтересів: відсутній.
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