

теорію діяльності до вивчення людської діяльності. Подальший розвиток теорії прикладної діяльності призвів до створення системно-структурної теорії діяльності (ССТД) як самостійного напрямку ТПД. Теорію заснував Григорій Бедний (2007). Створення ССТД значно вдосконалило науку про діяльність, оскільки її можна застосовувати для вивчення та практики людської праці. Основна увага в нашій роботі буде зосереджена на теорії системно-структурної діяльності (ССТД).

**Ключові слова:** теорія діяльності, теорія системно-структурної діяльності, термінологія теорії діяльності, саморегуляція діяльності.

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## FUNCTIONAL TRAINING IN THE ASPECT OF SPORTS TRAINING

*The article deals with issues of functional training and functional preparation in sport. Today, the focus on achieving the maximum competitive result determines the need for a rational system of sports training in the sport of the highest achievements based on modern achievements of science and practice. The generally accepted, traditional classification of its main types, which has developed so far in the sports training system, implies the division into physical, technical, tactical, mental and integral. This allows to plan the training tools and methods quite efficiently based on pedagogical principles and foundations. However, the methodological unification of sports training, based only on pedagogical principles, often leads to its reduction, the use of only standard, long-developed training plans, often projected at the same time not on one, but on a whole group of athletes. The further development and improvement of the theory and methodology of sports is due to the inevitable understanding of the athletes training system as a process of formation of the proper level of functional preparation through the influence of specific training effects – physical exercises on the human body. A high level of functional fitness is the result of body adaptation to physical exertion, therefore, the regularities of adaptation of physiological systems to muscle activity must be considered as a biological basis that provides the proper training effect. The existing variety of scientific studies and their results in the field of functional preparation and training, sometimes postulated as the methodological basis of sports training. The contradictions revealed during the analysis of scientific and methodological literature and some ambiguity in the results and conclusions of various authors determines the need for further studying of this problem, both in theoretical and practical aspects.*

**Keywords:** *functional preparation, functional readiness, sports training, adaptation, functional systems.*

### Introduction and the current state of the issue

Today, sport of the highest achievements is a very specific area of human activity. The goal of achieving the maximum competitive result, which involves achieving the highest level of readiness, determines the need for a rational system of sports training based on modern achievements of science and practice.

To date, the traditional classification of its main types is recognized in the system of sports training, involving division into physical, technical, tactical, mental and integral trainings. This classification allows to plan

training tools and methods quite efficiently, based on pedagogical principles and foundations. However, methodological unification, based only on the pedagogical principles of the formation of structural and meaningful components of sports training, often leads to its reduction, the use of only standard, long-developed and applied curriculums, often projected at the same time on not one, but on a whole group of athletes.

At the same time, not anyone has no doubt about the postulate that the person himself is the object of influence in sports training. And, since the human body is a rela-

tively open self-organizing and self-structuring system, constantly subjected to various and numerous environmental influences, it is necessary to take into account the fact that in any manifestation of its life, it inevitably obeys the general laws of adaptation, having systemic nature (Kyslenko, Bondarenko, Plisko & Bosenko et al., 2019).

#### **Aim and tasks**

The purpose of the research is to study the existing ideas about functional training in sports according to modern research, to establish problematic issues and promising areas of research in this field.

It was supposed to identify the initial concepts and prerequisites that determine the need to distinguish the functional training in the structure of sports training, determine the structural elements and properties of individual components of functional training, and study the modern ideas about the theoretical and practical aspects of functional training in the representation of various researchers to achieve the goal.

#### **Research methods**

The study was carried out with methods of analysis and synthesis of scientific and methodological literature on pedagogical, physiological and methodological aspects of the problem studied.

#### **Research results**

The further development of the theory and methodology of sports is due to the inevitable understanding of the athletes training system as a process of forming the proper level of functional readiness through the influence of specific training effects – physical exercises on the human body.

The realization of this led to the appearance of a new term that is not the part of the standard structure of sports training – “functional training” and its final result – “functional preparation”.

One of the first works that updated this direction is considered to be the work of G. K. Birzin “The Essence of Training”, published in 1925. Among a large number of very progressive ideas (the need for a gradual increase in training loads, the transition from general preparation to special, rational alternation of physical activity and rest etc.), the allocation of two main aspects of sports training deserves the most attention – “technical improvement” and “physiological training”, which emphasized the biological nature of sports training. However, as I. N. Solopov (2010) notes later L. P. Matveev (1967) interpreted this direction as “physical training”, significantly narrowing the essence of this process.

F. Genov (1971), can also be noted as someone, who proposed his own version of the athlete's readiness structure. In his opinion, physical fitness as a holistic structure which includes the following components: physiological fitness (which is determined by the adaptation changes that occur in the athlete's body as a result of training in a selected sport); psychological readiness (characterized by adaptive changes in the human psyche due to specific activities in a chosen sport); technical readiness (which is determined by the level of development of the athlete's ability to perform motor actions corresponding to the form and intensity) and social preparedness (as a unifying link determined by the motives of the sports activity per-

formed). Furthermore, he directly distinguished in physiological preparation such components as adaptation of the cardiovascular and respiratory systems work, adaptation of the work of the musculoskeletal apparatus, as well as adaptation of the central nervous system and other organs and systems to the requirements of selected sports activities.

The idea of functional training was further developed by V. S. Fomin. In his work “Physiological Foundations for the Management of the Training of Highly Qualified Athletes” (Fomin, 1984), he proposed a structure of functional fitness of an athlete based on the coordinated interaction of four basic components: mental, neurodynamic, energy and motor, aimed at achieving a given sports result. According to the author, the content of the mental component includes indicators of mental state (tension, stability), mental qualities (perception, attention, prediction and implementation of actions) and mental performance (determined taking into account the specifics of the chosen sport). The neurodynamic component includes the characteristics of cortical processes (excitability, mobility, stability etc.) and autonomic regulation (tension, stability). The energy component, in his opinion, consists of indicators of aerobic performance (general physical performance and endurance) and anaerobic performance (high-speed performance and endurance). Physical qualities (strength, speed, agility, flexibility), control (standard) exercises and game motor activity are highlighted in the structure of the motor component. The author notes that the first two components (psychic and neurodynamic) are control components, and the second two (motor and energetic) are execution components.

A significant amount of research work on the problem of functional training in theoretical and applied aspects was carried out at the Volgograd State Academy of Physical Culture. The works were carried out in different years: I. N. Solopov's doctoral dissertations (1996), N. N. September (2004), A. I. Shamardin (2000), A. A. Shamardin (2009), E. P. Gorardin, E. O. Gorbaneva (2012), as well as a number of master's theses on the study of various aspects of the problem under study.

The result of many years of research was the structure of functional preparedness of athletes, based on the structure proposed by V. S. Fomin (1984), and presented in the form of the following elements (Solopov, 2010): an information-emotional component, including processes of sensory perception, memory and emotional manifestations; regulatory component combining mechanisms of motor, vegetative, humoral and cortical contours of regulation; a motor component comprising musculoskeletal functions; energy component reflecting power, mobility, capacity and efficiency of aerobic and anaerobic mechanisms of energy production; a mental component manifested in the level of development of mental qualities, the level of mental state and mental performance.

According to the level of structuring, the information-emotional, regulatory and energy components make up the “basic level of functional preparedness”, the motor and mental components – the “pecially basic level of functional preparedness”. Furthermore, a “special level of preparation” is proposed, which is a superstructure over functional preparation, which includes physical,

technical and tactical types of preparation, through which, in the form of a specific motor function, functional capabilities are integrally manifested due to the development of the properties and qualities of the components of the first and second levels.

At the same time, the researchers themselves note the sufficient conditionality of the developed scheme and its excessive generalization. Therefore, it is suggested that the specific functions of each global component should be further specified and supplemented with qualitative characteristics: values of functional capacity, mobilization, sustainability, economics and specialization.

The result of the research, I. N. Solopov (2010) concludes that “the functional fitness of athletes is a basic, complex, multi-component property of the body, the essence of which is the level of perfection of physiological mechanisms, their readiness to ensure at the moment the manifestation of all the qualities necessary for sports activity, which determines, directly or indirectly, muscular activity, physical performance within the framework of a specific regulated motor act”.

There is no doubt that the training load cannot exist on its own. After all, in its essence, it is the result of the athlete's body functioning during his training and competitive activities. The training and competitive activity of athletes provides the training effect, which causes an appropriate functional reaction from the body (adaptation to physical activity or training effect).

In this regard, when studying the problem of functional preparedness, in our opinion, it is necessarily to consider the concept of adaptation in sports.

The concept of adaptation in a broad sense can be interpreted as the adaptation of an organism to its habitat, living conditions. However, the adaptation of the body of people who are involved in sports is more specific. That is because besides to the standard environmental impacts, typical for almost all people, the athlete's body experiences an additional, very significant effect - training loads almost every day. In this aspect, the most important area of sports physiology is the consideration of the central problem of sports training – adaptation to muscular activity.

The adaptation to muscular work is usually defined as structural-functional restructuring of the body, leading to an increase in efficiency, which allows the athlete to perform physical activities of greater power and duration, as well as to develop higher muscle efforts compared to an untrained person (Platonov, 2017).

As the leading biochemical and physiological mechanisms of adaptation to physical activity were formed during the long evolution of humans, they are fixed in their DNA structure, determining the innate mechanisms of adaptation inherited from parents. Such innate adaptation is called genotypic, determining the initial ability of the body to adapt to the performance of physical activity.

However, in addition to innate adaptation, the human body has the property of increasing its adaptive capabilities throughout its life. Such adaptation is commonly called phenotypic, referring here, for example, to all changes in the body due to the specifics of labor or sports activities.

In the physiological sense, the adaptation of the human body to external and internal influences consists precisely in maintaining homeostasis and, accordingly, the vitality of the body in almost any conditions to which the body is able to respond adequately.

According to the available ideas, the body adaptation to physical activity is phase-wise, involving two stages: the urgent stage and the long-term adaptation stage.

The urgent adaptation is expressed in the response of the human body to a single effect of the training load, and represents an “emergency” adaptation to the changed state of the internal environment. Advantageously, these reactions consist in changes in the energy exchange and activation of the higher nerve centers responsible for regulating muscle activity. The goal of urgent adaptation is primarily to create optimal conditions for working muscles for their functioning (primarily due to improving their energy supply), therefore, this adaptation stage is based on structural and functional restructuring that takes place in the body directly during muscle work.

The long-term adaptation is formed in the rest intervals between trainings, which involves more time. The biological importance of long-term adaptation consists in creation of structural-functional base in the organism necessary for further more successful implementation of urgent adaptation mechanisms, which allows to prepare athlete's organism for performance of subsequent physical exertions in more optimal mode.

It is believed that the concept of “adaptation” is inextricably connected with the concept of “stress” – the nonspecific reaction of the body to the effects of any sufficiently strong stimulus.

The theory of stress was first proposed by Canadian physiologist Hans Selier, who believed that three phases can be distinguished when exposed to a stressful stimulus: anxiety; resistance and exhaustion. In the anxiety phase, a set of physiological responses is formed and they ensure urgent body adaptation to physical activity. The resistance phase can be annealed with the concept of training: if the irritant force does not exceed the body's adaptive reserves, then the mobilization and redistribution of the body's energy and structural resources takes place, that is, the processes of specific adaptation are activated. At the same time, if the amount of training and competitive influences exceeds the limit level, then the depletion phase may occur: adaptation reserves are depleted and the sportsman's body is maladapted to excessive training loads.

As V. N. Platonov (2017) notes, in sports training, the reaction of the latter type is often noted when planning and performing excessive training loads that do not correspond to the current capabilities of the athlete, as well as long or repeated performance at competitions. The reaction of the second type is the main one in sports training, stimulating the formation of urgent and long-term adaptive changes that underlie systematic and expedient sports improvement.

The basis of these provisions is adhered to by a fairly large number of scientists conducting research in the field of sports training and physiology of sports. However, there are a number of studies that attempt to reveal the

contradictions in the existing system and the scientific reasoning of their own research direction.

A prominent critic of the classical interpretation of the formation of adaptation changes under the influence of physical activity is the Russian physiologist S. E. Pavlov, who notes a number of shortcomings, present in the generally accepted theory in his publications (Pavlov, 2017). Thus, in his opinion, nonspecific reactions in the "theory of adaptation" are presented exclusively by "stress", which by now, as edited by most authors, is completely devoid of its original physiological meaning. The term "stress", according to its original physiological meaning makes the adaptation process discrete, which already contradicts both logic and the laws of physiology. The existing ideas about the adaptation process are unacceptably mechanistic and primitive in nature (in the form of a linear adaptation-de-adaptation-readaptation sequence), which does not adequately reflect the essence of complex physiological processes that actually take place in a living organism.

In his opinion, the use of training loads, different in their physiological and energy criteria, in various structures of the training process (micro- or mesocycles) conflicts with the main goal of sports training, since a decrease in the level of specificity caused by the summation of actions of multidirectional factors will lead to an increase in the role of the non-specific irritant link and an increase in the threshold values of exposure strength. Therefore, the trainer must build a single target functional system in the athlete's body, consciously using the external and internal components necessary for it in its structure, which otherwise can be diverted to other functional systems.

He notes that the final formation of an adequate functional system as a response to the complex impact of standard, relatively constant in strength and specificity training loads is directly interconnected with the absolute body adaptation to them, which provided that a sufficient level of specificity of this complex with respect to the reference effect leads to a true peak in sports form. At the same time duration of functional system formation in compliance with the above conditions is determined by individual adaptation period, and the arising necessity of achievement in periods of long-term sports training of higher levels of sports training each time determines the change of dominant and formation of new functional system based on already reached level of training.

U. V. Verkhoshansky (2005) speaks out with similar criticism, accusing the current system of sports periodization of pedagogical formalism and ignoring medical and biological knowledge in the sports training system. Alternatively, he proposes a block system, positioning it as an unconventional form of organizing the training process in a one-year macrocycle, exclusively intended for high-class athletes. As a leading principle, the principle of concentration of loads is proposed, which provides concentration of means of one training direction at certain stages of training, which makes it possible to create a targeted mass training effect on specific functional systems of an organism with the help of a high volume of specific loads of optimal intensity.

The principal model of the block system of sports

training of U. V. Verkhoshansky includes a unit for activating the motor function of the neuromuscular apparatus by means of special physical training, increasing the aerobic power of the body and improving the basics of sports equipment at the optimal speed (power) of efforts; power increase unit (capacity) of power supply sources providing special operability and improvement of sportsman's technical skill due to the increasing intensity of competitive exercise; unit of maximum increase of organism energy potential and ability to use it efficiently and economically in the conditions of training and competitions.

At the same time, the author notes that the professional skill of the coach consists in the ability to adapt this idea to any mode of the body work and the calendar of competitions, taking into account the real level of fitness of the athlete.

A similar idea of ordering training blocks and mesocycles is proposed by V. B. Issurin (2010). In his opinion, the effective structure of sports training should be based on three types of mesocycle blocks: cumulative (dedicated to the development of basic abilities - aerobic endurance and muscle strength, as well as the general scheme of motion), transforming (on which more specific abilities develop (for example, aerobic-anaerobic or anaerobic endurance, special muscle endurance and proper technique in a selected sport), and implementation (designed for pre-competition training and aimed mainly at imitating competitive exercises, achieving maximum speed and recovery before upcoming competitions).

V. N. Seluyanov, within the framework of "Sports Adaptology", revealed the laws of planning training loads using simulation modeling (Seluyanov, 1992). He notes that the model he proposed works according to the, so the principles of planning the training process stem from the laws of adaptation. He proposed two models that imitating urgent and long-term adaptation processes in the body of athletes. A model that imitating urgent adaptation processes includes muscle consisting of muscle fibers of various types (oxidative, intermediate, glycolytic), cardiovascular and respiratory systems, as well as the elementary central nervous system. According to the author, the model allows you to explain the features of biochemical and physiological reactions when performing physical exercises of different intensities. The second model, which imitating long-term adaptation processes, includes muscle, immune, endocrine and central nervous systems. It allows to study long-term adaptation processes: changes in the mass of myofibrils, mitochondria in muscle fibers and cardiomyocytes, the mass of the glands of the endocrine system. V. N. Seluyanov believes that the mathematical modeling he proposed made it possible to develop fundamentally new approaches in building the training process not only in health physical culture education, but also in sports.

### Discussion

As the analysis of scientific and methodological literature showed, the concept of "functional preparedness" is quite complex and ambiguous. In general, it can be characterized as a relatively stable state of the organism, integratively characterized by the level of development of its functions significant for a selected type of sports activity and their specialized properties, which directly or

indirectly predetermine the effectiveness of competitive activity.

Since motor activity in sports is provided by the work of a significant number of systems and organs, functional fitness should not be interpreted as a separate, specialized property of any of these organs, but as a holistic execution of a functional system combining these systems and organs to achieve the necessary sports result.

A high level of functional fitness is the result of body adaptation to physical exertion, therefore, the laws of adaptation of physiological systems to muscle exertion must be considered as a biological basis that provides the proper training effect.

Each property, ability or motor quality of a person is based on certain functional capabilities of the body, which are based on specific functional processes and physiological mechanisms. The results of numerous scientific studies give reason to consider functional fitness as a physiological basis, which is the basis of all other traditional types of preparedness. After all, each type of athlete training, traditionally allocated in the structure of sports training, at its core contains the process of improving some functions of certain body systems.

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### Conclusion

To date, in the theory and methodology of sports training, sports physiology and related scientific disciplines, it is relevant to study physiological mechanisms, specific features of their development and improvement, as well as the functional capabilities of the athlete's body in connection with muscular activity at various stages of long-term adaptation to physical activity.

This makes it necessary to introduce a new component into the sports training system – functional training and, accordingly, functional preparation, their meaningful structuring, as well as the search for means, methods and forms of targeted impact on the structural elements of functional preparation.

The existing variety of scientific studies and their results in the field of functional preparation and training, sometimes postulated as the methodological basis of sports training, contradictions, revealed during the analysis of scientific and methodological literature, and some ambiguity in the results and conclusions of various authors determines the need for further study of this problem, both in theoretical and practical aspects.

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### **ФУНКЦІОНАЛЬНЕ ТРЕНУВАННЯ В АСПЕКТІ СПОРТИВНОЇ ПІДГОТОВКИ**

У статті розглядаються питання функціональної підготовленості в спорті. На сьогоднішній день в спорті вищих досягнень цільова спрямованість на максимальні змагальні результати зумовлює необхідність наявності раціональної системи спортивної підготовки, що базується на сучасних досягненнях науки і практики. Сформована до теперішнього часу в системі спортивної підготовки загальноновизнана, традиційна класифікація основних її видів, передбачає розподіл на фізичну, технічну, тактичну, психічну і інтегральну. Це дозволяє досить ефективно планувати кошти і методи тренування, виходячи з педагогічних принципів і основ. Однак методична уніфікація спортивної підготовки, яка базується лише на педагогічних принципах, часто призводить до її редукування, застосування лише стандартних, давно розроблених тренувальних планів, найчастіше що проектуються при цьому на цілу групу спортсменів. Подальший розвиток і вдосконалення теорії і методики спорту обумовлено неминучим розумінням системи підготовки спортсменів, як процесу формування належного рівня функціональної підготовленості за допомогою впливу на людський організм специфічних тренувальних чинників – фізичних вправ. Високий рівень функціональної підготовленості є результатом адаптації організму до фізичних навантажень, тому закономірності адаптації фізіологічних систем до м'язової роботи необхідно розглядати як біологічний базис, що забезпечує належний тренувальний ефект. Існуюча різноманітність наукових досліджень та їх результати в галузі функціональної підготовки та тренувань, іноді постулюються як методологічна основа спортивного тренування. Суперечності, виявлені під час аналізу науково-методичної літератури, та певна неоднозначність результатів та висновків різних авторів визначає необхідність подальшого вивчення цієї проблеми як в теоретичному, так і в практичному аспектах.

**Ключові слова:** функціональна підготовка, функціональна підготовленість, спортивна атлетична підготовка, адаптація, функціональні системи.

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