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The journal is intended for teachers, coaches, athletes, postgraduates, doctoral students research workers and other industry experts.

Contents Themes:
1. Physical education of different population groups.
2. Improving the training of athletes of different qualification.
3. Biomedical Aspects of Physical Education and Sports.
4. Human health, physical rehabilitation and physical recreation.
5. Biomechanical and informational tools and technologies in physical education and sport.
6. Management, psychological-educational, sociological and philosophical aspects of physical education and sport.
7. Historical aspects of the development of physical culture and sports.

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CONTENT

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HARMONIZATION PROBLEM OF USED METHODS REGARDING THE COMPLEXITY OF THE RESEARCH

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Purpose: systematization of modern scientific ideas on the harmonization problem of methods used in relation to the complexity of the research.

Material and methods: analysis of literary sources, archival materials, methods of historicism, analogies and similarities.

Results: the works and theories of scientists from different fields of scientific knowledge are analyzed, which established the general principles of self-organization of developing systems and are the basis for the construction of special semantic feature spaces. This gave a fundamentally new method of research that provides the necessary level of solution to many practical problems, which was not achieved by methods previously used.

Conclusions: each level of organization of scientific research needs adequate methods that have the necessary level of solving the tasks in scientific works. In the arsenal of used methods are widely used methods of analysis of results, presented in the form of verbal descriptions, tables, graphs, figures, video recording and analytical description of the obtained patterns. Based on the conventional concept, the validity

of which is confirmed by the general theory of self-organization of developing systems and economically sound principles of invariance of the laws of self-organization that they are equally acceptable in inanimate and living systems from biology, anthropology, pedagogy, psychology, including as well as social systems, which has significantly expanded the possibilities of scientific research in these fields of knowledge.

Keywords: method, theory, system, self-organization, semantic space.

Introduction

Physical culture, as an integral part of the holistic culture of society, carries the socially demanded components of interdependent obligations to meet the necessary needs, which include: educational, health and economic components.

The significance of these components does not remain the same in different forms of physical culture components related to the age of those who exercise, their individual physical development, purpose and motives.

Successful implementation of relevant functional responsibilities can be achieved with sufficient awareness of existing needs in society, which, of course, requires a certain level of observation of the qualitative structure of needs, the degree of their demand and the appropriate satisfaction of these needs.

The purpose of the study - is to characterize the systematized structure of modern scientific provisions on the problem of coordination of the methods used in relation to the complexity of the research.

Material and Methods of the research

Each study is aimed at achieving the goal, for which the relevant tasks are formed, which requires the necessary tools to solve them. Appropriate research methods are such a tool. Requirements for the possibility of solving the methods used are completely determined by the complexity of the tasks, which in turn are determined by the level of complexity of the research goal, which determines the construction of the chain "goal - task - methods".

The more complex the purpose of the study, the more important from the whole arsenal of research methods are mathematical descriptions of patterns, based on which a method of computer modeling, which is called "dynamic modeling". The use of this method allowed providing observation of the peculiarities of the dynamics of the studied processes, which cannot be solved by other methods.

It is the method of computer modeling on the basis of established patterns of dynamics of interdependent morphofunctional processes allows in real time to have information about the current state of the organism and on the basis of individual analogy of the established course of these processes to have information used to optimize their construction. In fact, the regularity of the process of external observation of the dynamics of the current state of the organism is manifested, and on this basis the regularity of the formation of the optimal mode of its construction is reflected.

The analogy of the observed patterns determines the validity of the use of computer mathematical modeling as a new research method that has the greatest potential in solving problems of modern research in the field of physical culture and sports. The above, in turn, creates the need to train the necessary specialists for the further development of physical culture and sports.

Results of the research

Throughout the period of development of different branches of scientific knowledge, the same task is set, aimed at understanding the patterns of those processes and phenomena that are observed and represent the object of their study. The division of scientific knowledge into separate branches is connected with the differentiation of social labor, but not with the laws that determine the process of development of self-organizing systems.

In the course of the development of certain branches, interdependent with public activity, scientific knowledge was accumulated as they became in demand. At the same time, the appropriate language of their expression was formed. At each stage of achieving a higher level of development of society there has always been a

desire to systematize knowledge in search of patterns of a single mechanism that would determine the behavior of self-organizing systems.

Speaking of this process, John Bernal (1901 - 1971) emphasized that "in science, more than in other institutions of mankind, it is necessary to study the past to understand the true domination of nature in the future" [19].

In the history of the development of science can not be said about the absolute priority of the discovery of basic laws. In each epoch, they were formed in a clearer form of their time by persons who had encyclopedic knowledge and their deep awareness. In various forms, these laws expressed the position that the like arises from the like and gives rise to the like, or the past gives rise to the present, in which the future arises.

The validity of a unified theory of self-organization was presented by Empidocles and Heraclitus. In their scientific practices, the provisions on the periodicity of the repetition of the process of self-organization, based on the continuous dynamics of the statistical ratio of the results of the struggle of two opposites, united in a single whole in the structure of dichotomous interactions, are set out with deep validity. At each stage of their realization, these statements had a more rigorous representation, expressed in clearer forms, logical justifications of the essence of the content of the process of self-organization of the material world. This reflects the orderly structure, which was established in the Hellenic period of its description and was interpreted as a "norm". The concept of "norm" in this period expressed the orderliness of relations, which are constantly changing the statistical dynamics of the interaction of two opposites.

This position is reached after a millennium by I. Kant, talking about the dynamic effect of inner feeling, which calculates the statistical image of the observed object, highlighting in it each time the basic and variable structure of its formation [11]. In the works of G.W.F. Hegel in the study of the concept of "norm" and the dynamics of its transformation, he comes to identify the universal law of thinking, which is based on the statistical principle of distinguishing a dynamic stereotype of behavior as a stable structure and the mandatory presence of a variable part that

reflects operational adaptive behavior, that ensures the preservation of the equilibrium state of the object with the forming environment of its stay [7].

In an effort to formalize these provisions, A. Quetelet [13] on the basis of the theory of statistics describes the formation of the image of observed phenomena of various natures, highlighting in them the basic structural formation and variable component, which are "strange" constancy. In assessing the human somatotype, he creates the image of the "average person", investing in it the meaning of the most stable structure of the somatotype, which is characteristic of a particular environment as a "whole object" and reflects the variable nature of its morphological and functional components regarding the norm of their interdependence of relations in a single whole that unites them.

Later, the idea expressed by I. Kant, comes from F. Galton in the construction of "collective photography", or the method of multiple layers of the studied image, which shows the statistical method of forming this image. Summarizing the theoretical approaches of I. Kant, G.W. F. Hegel in the study of the law of thought, E.V. Ilyenko comes to the conclusion that the universal method of thinking is inherent not only in man, but in all self-organized systems, no matter what affiliation they have in both animate and inanimate nature [7; 10; 11; 21].

Ya.A. Ponomarev comes to a similar conclusion [14] in the assessment of creativity as an operational process of adaptation to the dynamics of change of the educational environment, as an integral mechanism of operational search, providing interaction of differentiated entities that invest a dynamic stereotype of the norm between the object and the environment of its formation. In this case, there is a holistic system "environment-object-subject", where the subjects are interdependent areas of the whole organism as morphofunctional entities that carry out differentiated activities.

During the XIX and XX centuries, the commonality of the structure of the construction of methods of historicism, or chronological observation, the method of natural pedagogical experiment, developed by A.F. Lazursky, constructing a dynamic stereotype of behavior, revealed by A.A. Ukhtomsky, the phylogenetic process of

natural selection and inheritance of genetically determined traits in the process of ontogenesis. In all cases, the unifying organization is represented by a stable structure of a dynamic stereotype, which reflects the phenomenon under consideration and accompanies its operational adaptive behavior, which ensures the preservation of equilibrium in the relationship "object-environment" [5; 17].

Special contribution to the understanding of the process of self-organization was made by revealing the nature of tolerance and its decisive role in establishing the level of complexity of organizational processes. The degree of tolerance of these processes reflects the level of observation. The process of statistical accumulation and processing of the observed behavior provides an affordable degree of risk avoidance. The formation of the mechanism of observation and systematization of accumulated experience is a reflection of the process of differentiation of the educational environment into an orderly system of reflecting the sustainability of the birth of permanent relationships in interdependent obligations to perform functional activities. The statistical accumulation of the recurrence of this process determines the structure of their most stable recurrence.

This served as a basis for the construction of special semantic spaces with a degree of partial comparison of the degree of participation of their joint interaction in achieving the equifinal end result.

Simultaneous uniform "effort" of dichotomous interacting formations reflects the static voltage of statistical characteristics, which has no pulsation and is drawn in a rectangular coordinate system by a straight line. According to the introduced measure of the law of normal distribution, six sigma zones are distinguished, which form seven boundary points, which act as a measure of static voltage and change from their minimum in the first point to the limit maximum in the seventh. Each voltage measure is a static voltage rank.

If the simultaneous manifestation of effort has a difference, then there is a pulsation. This kind of dynamics of emerging efforts determines the kinematics of jointly conditioned interactions. In this case, we can talk about the pulsations of static voltage, which has a certain range on the scale of its rank characteristics and the

dynamics of changes in the forces reflected on the coordinate axes of dichotomous interacting formations. This technique was developed at the Kharkiv State Academy of Physical Culture and has been tested in many studies [1; 3; 16].

The obtained representations of the results of constancy of birth of permanent relations in the corresponding sign semantic spaces form a statistically accumulative image, which reflects the analytical dependence of these relations, which is a fundamentally new method of analysis of empirical data viability, which reveal the patterns of their interdependent relations of differentiated branches of the whole organism in ensuring the required level of its viability.

The presence of modern computer technology and appropriate software allows to solve the inverse problem according to the established laws, which is that the observed kinematics of the initially known data can restore the dynamic forces that determine the observed kinematics of movement, and the established characteristics of dynamic efforts to judge about the corresponding and determining their manifestation of static voltage, which reflects the potential for viability of the observed system. This research method is the main position of this study.

Conclusions / Discussion

In scientific research, the achievement of the formulated goal is always completely determined by the possible solvability of the tasks and adequate methods. In this case it is a question of comparability of the considered needs and adequate possibilities of their decision. Such an interdependent relationship can be established only if the comparable relationship between demand and satisfaction. Under natural conditions, this problem is solved in a purely empirical way with a certain degree of available trial and error, which has significant economic costs and low quality, which, in turn, limits the possible level of complexity of the organization of these relations.

The true nature of the construction of these relations is related to the definition of "norm" as an average value in explaining the "idea of norm" in aesthetics and was actually expressed by I. Kant in his work "Critique of judgment", in which he talks about the process of formation of clarity of expression of the studied image during his observation. As an example, he considers the process of constructing an image of a

person, pointing out that if “someone saw a thousand adult men and he wants to judge their normal size, determined by comparison, the imagination imposes a huge number of images on each other. And if we apply here the analogy with the optical image, then in the space where most of them meet and inside those outlines where the part is most densely painted, the average value becomes noticeable, which is equally distant in height and width from the extremes of the largest and the smallest figures. And this is the figure of a handsome man, if you measure all this thousand, add the height of all, as well as the width (and thickness) and the sum divided by a thousand. But the imagination does this through a dynamic effect that arises from the repeated grasping of such figures by the internal senses, *calculated statistically*" [11; 12].

In its historical development, the category of "measure" appears as fixing each time on a new basis the contradictions of the abstract and concrete, subjective and objective, and resolving these contradictions that lead to their reproduction at a higher level. With each step of cognition of the category of "measure" led G.W.F. Hegel to formulation a category that covers not only the unity of quantity and quality in a certain range of measurements (i.e. measures), but also the category that describes the process of transition from one type of measure to another. This category is called the "nodal line of measure". Change of measures of development (nodal line of measure) was presented by G.W.F. Hegel as *a universal law of thought* [7].

About the universal method of thinking, but in 1968 says E.V. Ilyenko. He notes that this is not a subjective-psychological technique by which a person "easier to understand" the subject, but the only logical form that allows to express in motion the concepts of "*objective process of self-distinction*" by which it arises, becomes, is formed and diversified within any "*organic whole*", or capitalism, feudalism or socialism, or biological whole (living organism), or any other *"holistic"* system of interacting phenomena. Therefore, the method of ascent from the abstract to the concrete can be considered as *a universal method of thinking* [10, p. 212].

At one time, this idea was almost completely solved by A. Quetelet during mass surveys of various anthropometric indicators, including the level of physical fitness of two thousand recruits during hostilities between the south and north of the

United States [13]. Based on these empirical data, the most common characteristic of the average person as a somatotype structure was established. Based on the revealed regularity, it was found that it is expressed by a binomial distribution. During conduction of the number of obtained materials, its asymptotic approximation was used, which is the law of normal distribution. This allowed to introduce the concept of "norms of population physical development", which later became known as the "*average person*".

Later, as in the description of I. Kant, the position on the formation of the image when viewed by thousands of men, when more clearly expressed those components that were layered on the top of each other, reflecting the picture of the middle type of body structure, which is most common and its components were invested in the idea of F. Galton's method [21] of multiple layers of photographs proportional in size to obtain the contour of the average person. The method used was called "*collective photography*". An important step in distinguishing the general from the private and assigning a quantitative description of the qualitative indicators of photographs was the operation of a single proportionality of these indicators. However, the high cost of the method led F. Galton to the statistical method of representation of each component of the body in its overall structure. In fact, the operation of dividing the quantitative characteristics, which reflects the size of the compared object and its qualitative structure was performed. Based on this, in the following times the concept of "*general average criterion and its variation relative to the obtained average value*" was formed. The characteristics of the average values reflected the partial ratio of the constituent components of the body in the overall structure of "collective photography" [1].

More accessible and acceptable for practical use was the method of "clinical anthropometry", developed by M.Ya. Breitman in the first quarter of XX century [6]. The essence of the method was to determine the assessment of the proportionality of fifteen elements of the body in relation to their linear dimensions to its length, which characterize the qualitative structure of the construction of the considered somatotype. An important feature of this method was that a single element of the

overall structure was displayed in fractions of a unit, or as a percentage of the whole, which was the length of the body. Based on the idea of endocrine theory of control of metabolic processes, M.Ya. Breitman interpreted the features of partial size relations in the construction of the structure of the somatotype as an external reflection of the peculiarities of metabolic processes occurring in the body. On the basis of a large volume of practical clinical observations, he developed the theory of prenosological diagnosis and its course in time, which allowed us to speak not only about the direction of inconsistency, but also about the strength of its manifestation. The standard of comparison was based on the principle of constructing the "average person" as the most characteristic viable structure of the observed norm of somatotype in the appropriate environment of his stay.

A similar idea of the external reflection of the internal features of metabolic processes comes W. Sheldon in a quarter of a century, but in the second half of XX century [22]. He builds his theory on the relationship between the external structure of the somatotype and the phylogenetic conditionality of its formation, based on the role of partial participation of "*embryonic petals*", which identified three basic types in the classification of the structure of somatotypes, which are expressed as ecto-, endo- and mesodermal. In essence, this kind of construction of his theory, he used the method of representation of the "*average person*" by A. Quetelet and the method of "*collective photography*" by F. Galton.

In the graphical representation of his research results, he used the Gibbs-Roseboom equilateral triangle, widely used at the time, which is practically a reflection of the three-dimensional representation of the jointly conditioned interaction of three independent characteristics that act as coordinate axes of a "single cube". This is a cube in which each edge is equal to one and divided into six equal parts according to the entered sigma distribution when placing the density of the observed feature in accordance with the law of normal distribution. In this case, there are seven points that are outside the sigmoid zones of division of each coordinate axis. The intersection of this unit cube with a plane perpendicular passing through its three vertices gives rise to the Gibbs-Roseboom triangle. This explains the seven-

point scale, which is used to assess the activity of "embryonic petals" in the formation of the corresponding structure of the somatotype [1; 4].

In all these approaches to the distribution of quantitative representation of the volume of jointly determined interacting, independent characteristics and their partial ratio of the qualitative structure of the generated formation by default there is an extremely important position revealed by Geoffroy Saint-Hilaire (1836) on the need to separate mass growth and its formation and interdependent processes in the course of developing systems [8].

In the third quarter of the XX century, almost simultaneously, general theories of self-organization of developing systems were developed, which were presented in the works of L. Bertalanffy [20], K.P. Anokhin [2], Lotfi A. Zadeh [9; 23]. Each of them revealed different aspects of the process of self-organization of developing systems, and was aimed at substantiating the general principles of self-organization of developing systems, regardless of the nature of their affiliation, based on the conventional concept of H. Poincaré, which states that "the division of sciences in some areas due not so much to the nature of things as to the limitations of human cognition. In fact, there is a continuous chain from physics, chemistry, through biology and anthropology to the social sciences, a chain that can not be broken anywhere, except by arbitrariness "[15].

On the basis of them, as complementary to each other, a general theory of self-organization of developing systems was developed, which is interpreted as "humanistic systems" and according to the common definition given to them by G. Hacken [18], they are called "synergetic".

Thus, it is established that an important provision of the general theory of development of self-organizing systems is the statement that each level of organization and its complexity requires adequate research methods that have the necessary and sufficient ability to solve research problems or analyze their results. The obtained modern research methods using special semantic feature spaces in no way deny the whole variety of the existing arsenal of research methods, as they are the root basis on which the method of computer mathematical modeling is based.

An important requirement for the effective use of research methods is their adequacy to the required level of ability to solve the problem and the appropriate way of presenting it in the form of verbal descriptions, tables, graphs, figures, analytical expressions that reflect the revealed patterns, based in all cases on the conventional concept, the validity of which is substantiated by the general theory of self-organization of developing systems, which approved the principle of invariance of the laws of self-organization.

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References

1. Azhippo, A. Yu, Pugach, Ya. I., Pyatisotskaya, S .S., Zhernovnikova, Ya. V., Druz, V. A. (2015), Ontologiya teorii postroeniya kontrolya i otsenki urovnya fizicheskogo razvitiya i fizicheskogo sostoyaniya [Ontology of the theory of constructing control and assessing the level of physical development and physical condition], Harkov: HGAFK; 192 p. (in Russ.).
2. Anohin, K. P. (1974), Obschaya teoriya funktsionalnyih sistem organizma [General theory of the functional systems of the body], Moskva, pp. 52 – 110. (in Russ.).
3. Ashanin, V. S., Pugach, Ya. I. (2014), Postroenie semanticheskih prostranstv dlya opisaniya psihosomaticheskoy deyatelnosti cheloveka v ekstremalnyih usloviyah [The construction of semantic spaces to describe the psychosomatic activity of a person in extreme conditions]: uchebnoe posobie, Harkov: HDAFK, 88 p. (in Russ.).
4. Balk, M. B., Boltyanskiy, V. G. (1987), Geometriya mass [Mass geometry], Moskva: Nauka, 160 p. (in Russ.).
5. Behterer, V. M. (1991), Ob'ektivnaya psihologiya. Pamyatniki psihologicheskoy myisli [Objective Psychology. Monuments of psychological thought]. Moskva: Nauka, 478 p. (in Russ.).

6. Breytman, M. Ya. (1949), Klinicheskaya semiotika i differentsialnaya diagnostika endokrinnyih zabolevaniy [Clinical semiotics and differential diagnosis of endocrine diseases], Leningrad: Gosudarstvennoe izdatelstvo meditsinskoy literaturyi, Leningradskoe otdelenie, 636 p. (in Russ.).
7. Gegel, G. W. F. (1975), Nauka logiki: sochineniya [The Science of Logic: Works], Tom 1, Moskva: Myisl, 454 p. (in Russ.).
8. Zhofrua-Sent-Iler (1836), Obschaya i chastnaya istoriya anatomii teloslozheniy [General and private history of body anatomy], Parizh. (in Russ.).
9. Zade, L. A. (1974), Osnovyi novogo podhoda k analizu slozhnyih sistem protsessov prinyatiya resheniy. Matematika segodnya. [The foundations of a new approach to the analysis of complex systems of decision-making processes. Math today] Moskva: Znanie, pp. 5–49. (in Russ.).
10. Ilenkov, E. V. (1968), Problema abstraktnogo i konkretnogo v svete «Kapitala» Marksa. Filosofiya i sovremennost [The problem of the abstract and the concrete in the light of Marx's “Capital”. Philosophy and Modernity,], Moskva, pp. 186–213. (in Russ.).
11. Kant, I. (1966), Kritika sposobnosti myishleniya. Sochineniya [Critique of the ability of thinking. Compositions], T.5. Moskva: Nauka, pp. 238 – 239. (in Russ.).
12. Kant, I. (2017), Kritika chistogo razuma [A Critique of Pure Reason], per. s nem. i predisl. N. Losskogo. Sankt-Peterburg: Azbuka-Attikus, 766 p. (in Russ.).
13. Ketle, A. (1911), Sotsialnaya fizika [Social Physics], Sankt-Peterburg, 241 p. (in Russ.).
14. Ponomarev, Ya. A. (1976), Psihologiya tvorchestva. Akademiya nauk SSSR. Institut psihologii [Psychology of creativity. USSR Academy of Sciences], Moskva: Nauka, 302 p. (in Russ.).
15. Puankare, A. (1983), O nauke [On Science]. Moskva: Nauka, 260 p. (in Russ.).
16. Pugach, Ya. I. (2013), "Fundamentals of constructing a semantic space for an orderly presentation of research results", «B'deschego v'prosi ot sveta naukata»: materialyi IX Mezhdunarodnoy konferentsii, Sofiya: Byal Grad-BG, Tom 39, pp. 13–15. (in Russ.).

17. Uhtomskiy, A. A. (1966), Fiziologiya cheloveka [Human physiology] / pod red. EB. Babskego. Moskva: Meditsina, pp. 23 – 656. (in Russ.).
18. Haken, G. (1985), Sinergetika ierarhii neustoychivostey v samoorganizuyuschihsya sistemah i ustroystvah [Synergetics of the hierarchy of instabilities in self-organizing systems and devices], Moskva: Mir, 423 p. (in Russ.).
19. Hramko, Yu. A., Bernal Dzhon Desmond (1983), Fiziki: bibliograficheskiy spravochnik [Physicists: bibliographic reference] / pod red. AI. Ahiezera. Izd. 2-e ispr. i dopoln., Moskva: Nauka, p. 29. (in Russ.).
20. Bertalanffy, L. (1969), General system theory. New York, 289 p. (in Eng).
21. Galton, F. (1989), Natural inheritance. London: Macmillan, 266 p. (in Eng).
22. William H. Sheldon (1940), The varieties of human physique: An introduction to constitutional psychology? New York: Harper & Brothers. (in Eng).
23. Zadeh, L. A. (1965), Fuzzy sets. Information & Control, Vol. 12, pp. 94-102. (in Eng).

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THE CARDIORESPIRATORY SYSTEM STATE OF THE 10TH-11TH GRADE BOYS AFTER THE INTRODUCTION OF THE VARIABLE MODULE "CROSSFIT"

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Purpose: to determine the cardiorespiratory system state of the 10th-11th grade boys after the introduction of CrossFit exercises.

Material and methods: theoretical analysis and generalization of scientific methodological literature; biomedical methods for determining the physical health of pupils (spirometry, tonometry, pulsometer, Stange's test); pedagogical experiment and methods of mathematical statistics. The cardiorespiratory system state was determined by indicators of the regulation level of the cardiovascular system (Robinson's index) and the functional capabilities of the respiratory system, and the body's resistance to hypoxic phenomena (Skibinski's index). Resting heart rate (bpm-1), systolic blood pressure (mmHg), lung capacity (ml), breath retention time at inhalation (Stange's test) (s) were determined to calculate indicators. The obtained indicators were calculated for the formulas: HR (bpm-1) × BP Syst. (mmHg)/100 (Robinson's index); LC (ml) × Stange's test (s)/HR (bpm-1) (Skibinski's index). The examined results were compared to the scale and evaluated with a certain number of scores. Statistical analysis: the research materials were processed using the licensed Excel program. In the research 52 pupils of the 10th-11th grades took part.

Results: it was established that the cardiorespiratory system state improved after the introduction of CrossFit exercises into the educational process on physical education of the 10th-11th grade boys.

Conclusions: the positive effect of CrossFit exercises on the state of cardiorespiratory system of 10th-11th grade boys of main groups was found.

Keywords: CrossFit, senior pupils, cardiovascular system, respiratory system, physical culture lessons, motor activity.

Introduction

The deterioration of pupils' health state is the global problem nowadays. According to the Ministry of Health of Ukraine, for about 90% of children and adolescents have various health conditions [3; 10].

Specialists of the physical education industry note that the deterioration of pupils' health state is primarily due to a significant decrease in motor activity, imperfection of physical education at school, intensification of academic load, lack of free time, disregard of physical and labor education and expansion of modern media network [2; 4; 5; 10; 12].

A sedentary lifestyle is reflected by negative changes in activity of the cardiovascular system (strength of heart contractions weakens, arterial hypertension, ischemic heart disease develops and vegetal dystonia progresses); respiratory (vital capacity of lungs, maximum oxygen consumption, and etc. decrease) [10].

According to references, it was found that physical culture is important in the formation of healthy generation. However, a number of authors note that the system of physical education in educational institutions mainly function ineffectively [6; 11; 13; 18; 19]. It should be noted that the Ministry of Education and Science of Ukraine notes the need to supplement the State program of physical education for institutions of general secondary education with innovative, modern and interesting types of motor activities for pupils, which in turn will be able to optimize the educational process on physical education at school. Therefore, today, the question of the

inclusion of innovative technologies in the system of school physical education remains relevant.

In recent years, a number of researchers have devoted the considerable attention to the development of new approaches, which in turn will contribute to the modernization of the educational process on physical education [1; 3; 10-12]. The authors investigated the impact of various new means and technologies on the level of development of physical health, physical performance, and physical fitness in the process of physical education [3; 10; 11; 17; 20].

So, authors Bala, et al. (2018) determined the effect of cheerleading activities on functional state of the respiratory system of 10-16 year old adolescents; Masliak, et al. (2018) investigated physical health of 14-15 year old pupils under the influence of the multi-level differentiated learning exercise system; Masliak, et al. (2018) found the positive effect of cheerleading activities on functional state of the cardiovascular system of 10-16 year old adolescents; T. M. Bala, I. P. Masliak (2011) investigated the change in the level of health state of the 7^{th}- 9^{th} grade pupils under the influence of cheerleading exercises; I.P. Masliak (2017) established the influence of power aerobics on the cardiorespiratory system state of senior pupils. It should be noted that the question regarding the influence of CrossFit exercises on the cardiorespiratory system indicators of senior pupils in modern Ukrainian literature wasn’t found by us, which proved the feasibility of conducting our research.

Today, CrossFit is gaining wide popularity among modern youth. It should be noted that the overwhelming feature of CrossFit is that it is possible to attract to classes different age and gender contingent and there are many variations in the combination of exercises [21].

Thus, we believe that the introduction of exactly CrossFit to the substantive side of the educational process of physical education is appropriate, because it will diversify physical education lessons, make them more interesting and effective, increase the interest of pupils to physical education and sports, increase motor activity and, as a result, improve the cardiorespiratory system state of pupils.

Connection of the work with scientific programs, plans, topics. The research was conducted in accordance with the Thematic Plan of the research work of Kharkiv state academy of physical culture for 2016-2020 under the theme “Improvement of physical education in various educational institutions” (the state registration number 0115U006754) and for 2020-2026 "Improvement of the physical education process of different segments of the population" (the state registration number 0120U101110).

The purpose of the research is to determine the cardiorespiratory system state of the 10^{th}-11^{th} grade boys after the introduction of CrossFit exercises.

Material and Methods of the research

During the experiment, the following methods were used: theoretical analysis and synthesis of scientific methodological literature; biomedical methods for determining the physical health of pupils (spirometry, tonometry, pulsometer, Stange’s test); pedagogical experiment and methods of mathematical statistics.

The cardiorespiratory system state was determined by indicators of the regulation level of the cardiovascular system (Robinson's index) and the functional capabilities of the respiratory system, and the body's resistance to hypoxic phenomena (Skibinski's index). Resting heart rate (bpm^{-1}), systolic blood pressure (mmHg), lung capacity (ml), breath retention time at inhalation (Stange’s test) (s) were determined to calculate indicators. The obtained indicators were calculated for the formulas: HR (bpm^{-1}) × BP Syst. (mmHg)/100 (Robinson’s index); LC (ml) × Stange’s test (s)/HR (bpm^{-1}) (Skibinski’s index). The examined results were compared to the scale and evaluated with a certain number of scores.

Statistical analysis: the research materials were processed using the licensed Excel program. Calculated: arithmetic mean of the variation series ($\bar{X}$) - for the characteristic of the population after individual parameters; representativeness error (m) for determining the deviation of the arithmetic mean from the corresponding parameters of the general population; reliability of differences (p) - was calculated in order to establish the homogeneity of control and main groups, the degree of differences in indicators in the age aspect and changes in the average values of the

studied parameters in main and control groups after the experiment using Student's parametric criterion (t) with the significance level not lower than 0,05.

The research was carried out on the basis of the comprehensive schools No. 146 and No. 57 in Kharkov during the 2017-2018 school years. In the research 52 pupils of the 10^{th}-11^{th} grades took part. All the children who took part in the research were almost healthy and were under the supervision of a school doctor. During the research the pupils of control groups were engaged only in the generally accepted state program on physical education for 10-11 grades of general secondary education institutions, and the educational process on physical education of the pupils of the main groups was supplemented by the developed by us CrossFit variant module. CrossFit classes were held twice a week, according to the school schedule. The content of which included theoretical information, special physical training (elements of gymnastics, athletics and weightlifting, kettlebell lifting, general development exercises) and technical training (specially selected exercises for CrossFit “Burpee”, “Box Jump”, “Farmer's Walk”, “Good morning”, “Bear crawl”, “Floor wipers”, “Burpee bench jump”, etc. At the end of the research of the CrossFit module, pupils performed the complex of exercises, which consisted of special and technical elements of CrossFit, for a minimum period of time and with a noted number of rounds (“Cindy**”, “**Annie**”, “**Fran**”,** etc.) [16].

Age, sexual and anatomical-physiological pupils’ features were taken into account during the classes. The load and dosing increased gradually, taking into account the individual capabilities of pupils. CrossFit exercises were also included in the preparatory part of lesson of other variable modules in the system of organized breaks and were given in the form of homework.

Results of the research

Considering the obtained results (Table 1), which show the cardiorespiratory system state, the absence of reliable differences between the indicators of pupils of control and main groups was found ($p>0,05$).

Table 1

Comparison of average parameters of the cardiorespiratory system of the 10th-11th grade boys of main and control groups before the experiment

Indexes	Indicators / Groups		10 grade		Points per indexes		Normative valuation (points)	11 grade		Points per indexes		Normative valuation (points)
			n	$\overline{X}$ ± m	MG	CG		n	$\overline{X}$ ± m	MG	CG	
Robinson's	BP Syst. (mmHg	MG	15	115,27± 0,79	88,9	89,5	3	10	122,60± 2,32	90,6	86,1	3
		CG	10	116,60± 2,18				17	120,71± 0,73			
		t	0,57					0,78				
		p	>0,05					>0,05				
	HR (bpm^{-1})	MG	15	77,13± 2,34				10	73,90± 1,27			
		CG	10	76,80± 3,13				17	71,41± 1,41			
		t	0,09					1,31				
		p	>0,05					>0,05				
Skibinski's	LC (l)	MG	15	2,81± 0,15	1202	1231	2	10	2,89± 0,11	1270	1519	2
		CG	10	2,91± 0,13				17	3,11± 0,04			
		t	0,48					1,89				
		p	>0,05					>0,05				
	Stange's test	MG	15	33,00± 2,08				10	32,50± 1,72			
		CG	10	32,50± 1,42				17	34,88± 1,73			
		t	0,20					0,98				
		p	>0,05					>0,05				

Analysis of the results that depict the cardiovascular system state (Robinson's index) in the age aspect showed that when comparing the obtained results of systolic blood pressure and heart rate at pupils of both research groups, there wasn't reliable differences in indicators with the overall tendency to improve the results with age (p>0,05).

Comparing the obtained results according to Robinson's index with the scoring scale presented by S. D. Polyakov and co-authors [14], it is determined that they meet the score of 3 points ("average" level) at senior pupils of both research groups.

Analysis of the results that depict the cardiovascular system state (Robinson's index) obtained after using CrossFit exercises (Table 2) revealed significant decrease in heart rate of the 10^{th}-11^{th} grade boys and increase in systolic blood pressure data at the 11^{th} grade pupils of the main group ($p<0,05$-$0,001$). The exception is the results of the 10^{th} grade pupils, where there is an unreasonable increase in systolic blood pressure indicators ($p>0,05$).

Table 2

Comparisons of average parameters of the cardiorespiratory system of the 10^{th}-11^{th} grade boys of main groups before and after the experiment

Indexes	Indicators / Groups		10 grade		Points per indexes		Normative valuation (points)	11 grade		Points per indexes		Normative valuation (points)
			n	$\overline{X} \pm m$	Before	After		n	$\overline{X} \pm m$	Before	After	
Robinson's	BP Syst. (mmHg	Before	15	115,27 ± 0,79	88,9	80,8	3	10	122,60 ± 2,32	90,6	84,7	3
		After	15	117,13 ± 1,78				10	125,00 ± 1,59			
		t	1,01					3,09				
		p	>0,05					<0,05				
	HR (bpm^{-1})	Before	15	77,13± 2,34				10	73,90± 1,27			
		After	15	69,00± 1,46				10	67,80± 1,11			
		t	5,79					12,66				
		p	<0,001					<0,001				
Skibinski's	LC (l)	Before	15	2,81± 0,15	1202	2506	3	10	2,89± 0,11	1270	2799	3
		After	15	3,93± 0,08				10	4,10± 0,09			
		t	7,97					16,42				
		p	<0,001					<0,001				
	Stange's test	Before	15	33,00± 2,08				10	32,50± 1,72			
		After	15	44,00± 1,39				10	46,30± 2,84			
		t	8,45					8,03				
		p	<0,001					<0,001				

Considering the data obtained after the experiment it was found in the age aspect that the nature of the differences didn't change significantly compared to the output data at pupils of the main groups.

Analysis of the results of the pupils of control groups obtained after the experiment found insignificant changes in cardiovascular regulation indicators. In the age aspect the tendency of differences after the experiment didn't change significantly compared to the initial researches.

When comparing the data of main and control groups obtained after the experiment, it was found that the indicators of main groups are significantly better than the results of the pupils of control groups ($p<0,05$). The exceptions are indicators of systolic blood pressure, where the differences in the obtained results are unreliable ($p>0,05$).

Comparing the repeat Robinson's index scores with the scoring scale, it is determined that the results improved at the pupils of main groups after the experiment, somewhat, however, this didn't appear in any way on the scoring scale, and they, as at the beginning of the research, equal the score of 3 points, which indicates "average" level of cardiovascular regulation. The data remained unchanged and correspond to the score of 3 points ("average" level) for the boys of control groups.

Analysis of the results, which characterize functional capabilities of the respiratory system, and the body's resistance to hypoxic phenomena (Skibinski's index), in the age aspect showed that the increase in vital capacity of lungs and Stange's test with age, and the decrease in heart rate at boys of the research groups are observed. It should be noted that these differences are unreliable in both primary and control groups ($p>0,05$).

Comparing the results obtained according to Skibinski's index with the assessment scale presented by S. D. Polyakov and co-authors [14], it is determined that indicators of pupils of all study groups correspond to the score of 2 points, which equals "below the average" level.

Analyzing the results obtained after using CrossFit exercises (Table 2), it was found that there was a reliable improvement in the investigated indicators at the boys of main groups ($p<0,001$). Considering the data obtained after the experiment, in the

age aspect, it was found that the nature of differences didn't change significantly compared to the initial data at the pupils of main groups.

Analysis of the results of pupils of control groups obtained after the experiment revealed insignificant changes in respiratory system indicators. The tendency remained unchanged compared to the initial data in the age aspect.

When comparing the data of main and control groups obtained after using CrossFit exercises, it was found that indicators of main groups are significantly better than the results of pupils of control groups ($p<0,05$-$0,001$).

Comparing the repeated results according Skibinski's index [14] with the assessment scale, it is determined that the data improved by 1 point, and began to meet the score - 3 ("average" level) at the 10^{th} -11^{th} grade boys of main groups. The rates of the 10^{th} -11^{th} grade boys of control groups remained unchanged in comparison with the data of the initial research and met the score - 2 ("below the average" level).

Thus, the conducted researches indicate the positive impact of CrossFit exercises we proposed on indicators that characterize the cardiorespiratory system state of the 10^{th} -11^{th} grade pupils, which makes it possible to recommend that physical education teachers include in the educational process on physical education of senior pupils, which we developed the variant module "CrossFit".

Conclusions/Discussion

The results of the research found that CrossFit exercises in the process of physical education of the 10^{th} -11^{th} grade boys contributed to the improvement of the cardiovascular system. So, considering the changes in systolic blood pressure values obtained after the experiment, the significant increase in data the 11^{th} grade pupils ($p<0,05$) and the significant increase in results of the 10^{th} grade boys of main groups ($p>0,05$) were found. The above is confirmed by the results presented by A.S. Solodkov and Y.B. Solohub (2001), according to which blood pressure increases with age. In our opinion, the above changes in the body are explained by the increase in volume of blood that is thrown out by the heart in one contraction with age.

When examining the heart rate values obtained after applying CrossFit exercise, the reliable decrease ($p<0,001$) was established. The obtained results coincide with the data of I.Kh. Vakhitov and O.P. Martyanov (2010), which indicate the economy of heart functions and is consistent with the main patterns of the age development of adolescents in this period. So, the data of I.I. Zemtsova (2008) indicate that systematic exercise of prolonged, moderate intensity affects the decrease in heart rate.

Analysis of the results of pupils of control groups obtained after the experiment found insignificant changes in cardiovascular regulation indicators.

Studying the obtained indicators, after the introduction of the developed by us CrossFit variable module on physical education of senior pupils into the educational process, we can see the tendency to improve the functioning of the respiratory system. Considering the changes in indicators of vital capacity of lungs obtained after the experiment, there is the reliable increase in indicators of boys of main groups ($p<0,001$). The obtained results are consistent with the data of S.N. Blynkov, A.V. Krylova, S.P. Levushkin (2008), respectively, exercises on endurance and speed and power character have a positive effect on vital capacity of lungs of this age period. In our opinion, this is due to the fact that systematic exercises increase the functionality of the respiratory system, which in turn contributes to improving the indicators of vital capacity of lungs.

Analyzing the results, which reflect the body's resistance to hypoxic phenomena (Stange’s test), after the experiment, the reliable increase in indicators at boys of main groups was established ($p<0,001$). The obtained data are consistent with research of L.M. Kukis (2008), which found the positive effect of sports games on indicators of anaerobic capabilities of the respiratory system of adolescents. This is due to the fact that as a result of systematic exercise, the level of oxygen consumption significantly increases, blood circulation improves, metabolism activates and the body's resistance to hypoxic phenomena increases.

When examining the boys of control groups obtained after applying CrossFit exercises, minor changes in the respiratory system performance were established.

The results are confirmed by a number of researches: so, I.P. Masliak (2017) notes that the use of power aerobics exercises in physical education of the 10^{th} -11^{th} grade pupils positively affected the functioning of the cardiorespiratory system; N.V. Moskalenko, D.S. Yeliseieva (2016) found that dance aerobics activities, body ball, athletic gymnastics and jogging positively influenced the morphofunctional indicators of senior pupils' body; O.V. Andreieva, I.O. Pidhayna (2019) determined the positive impact of classes with aqua-recreation elements on health indicators of 16-17 year old boys.

Thus, the conducted researches indicate the positive impact of the offered by us CrossFit exercises on the cardiorespiratory system state of the 10^{th} -11^{th} grade boys.

The prospects for further research in this direction may be to determine the extent to which CrossFit classes affect senior pupils' physical health.

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References

1. Andrieieva, O. V., Pidhaina, V. O. (2019), "Influence of classes with elements of water recreation on the health of young people aged 16–17", Naukovyi chasopys NPU imeni M. P. Drahomanova, Vyp. 3K (110), pp. 35–39. (in Ukr.).
2. Arefiev, V. H. (2014), "Adolescent health and physical activity", Visnyk Chernihivskoho natsionalnoho pedahohichnoho universytetu, Vyp. 118 (3), pp. 6–10 (in Ukr.).
3. Bala, T. M., Masliak, I. P. (2011), "Changing the level of physical health of students in grades 7–9 under the influence of cheerleading exercises", Sportyvnyi visnyk Prydniprovia, No. 2, pp. 21–23 (in Ukr.).
4. Bala, T. M., Tseluiko, N. M., Kostiuk, A. V., Arkhypova, A. V. (2018), "The state of the cardio-respiratory system and individual motor abilities of students aged

16–17", Materialy IV Vseukrainskoi naukovo-praktychnoi konferentsii "Aktualni problemy fizychnoho vykhovannia riznykh verstv naselennia", pp. 14–21 (in Ukr.).

5. Blinkov, S. N., Kryilova, A. V., Levushkin, S. P. (2008), "The influence of the system of physical fitness work on the physical condition of rural schoolchildren", Fizicheskaya kultura, vospitanie, obrazovanie, trenirovka, No. 6, pp. 75–77 (in Russ.).

6. Bala, T. M., Petrova, A. S. (2019), "Analysis of the attitude of high school students to innovative motor activities in the system of school physical education", Slobozhanskyi naukovo-sportyvnyi visnyk, No. 4 (72), pp. 33–37 (in Ukr.).

7. Vahitov, I. H., Martyanov, O. P. (2010), "Dynamics of heart rate, stroke volume of blood and anthropometric indicators of basketball players in the process of many years of sports training", Teoriya i praktika fizicheskoy kulturyi, Vip. 7. pp. 86–88. (in Russ.).

8. Zemtsova, I. I. (2008), Sportyvna fiziolohiia [Sports physiology], navchalnyi posibnyk, Kyiv, 206 p. (in Ukr.).

9. Kukis, L. M. (2008), "Russian bast shoes and its elements as an effective means of influence on children of secondary school age", Fizicheskaya kultura: vospitanie, obrazovanie, trenirovka, No. 5, pp. 17–20 (in Russ.).

10. Masliak, I. P. (2017), "Influence of aerobics of power orientation on a condition of cardiorespiratory system of schoolboys of senior classes", Naukovyi chasopys NPU imeni M. P. Drahomanova, Vyp. 1 (82), pp. 35–38 (in Ukr.).

11. Mameshyna, M. A. (2020), "Differentiation of the content of physical education classes taking into account the indicators of physical health and physical fitness of students of 7–9 grades", Slobozhanskyi naukovo-sportyvnyi visnyk, No. 6 (74), pp. 25–31 (in Ukr.).

12. Moskalenko, N. V., Yelisieieva, D. S. (2016), "The impact of innovative health promotion technology on the physical condition of high school students", Naukovyi chasopys NPU imeni M. P. Drahomanova, Vyp. 3K 1 (70), pp. 109–113 (in Ukr.).

13. Platonova, A. G., Podrigalo, L. V., Sokol, K. M. (2013), "The rationale for the use of motor activity of children as a criterion for the effectiveness of recovery and

recreation", PedagogIka, psihologIya ta mediko-bIologIchnI problemi fIzichnogo vihovannya i sportu, Vip. 11, pp. 72–76 (in Russ.).

14. Polyakov, S. D., Hruschev, S. V., Korneeva, I. T. (2006), Monitoring i korrektsiya fizicheskogo zdorovya shkolnikov [Monitoring and correction of physical health of students], Metodicheskoe posobie, Moskva, 96 p. (in Russ.).

15. Solodkov, A. S., Sologub, E. B. (2001), Fiziologiya cheloveka. Obschaya. Sportivnaya. Vozrastnaya [Human physiology. The total. Athletic. Age], Uchebnik vyisshih uchebnyih zavedeniy fizicheskoy kulturyi, Moskva, 520 p. (in Russ.).

16. Fizychna kultura v shkoli : navchalna prohrama dlia 10–11 klasiv zakladiv zahalnoi serednoi osvity [Physical culture in school : curriculum for 10–11 grades of general secondary education] (2019), Kyiv : Litera LTD, 192 p.

17. Aghyppo, A., Kuzmenko, I., Masliak, I., Shesterova, L., Bala, T., Krivoruchko, N., Dorofeeva, T. (2018), "The influence of specially directed exercises on the functional state of the tactile analyser and physical fitness of 7–15 year old pupils", Sport science international scientific journal of kinesiology, pp. 70–77 (in Eng.).

18. Masliak, I. P, Mameshina, M. A (2018), "Physical health of schoolchildren aged 14-15 years old under the influence of differentiated education", Pedagogics, psychology, medical-biological problems of physical training and sports, Vol. 20 (2), pp. 92–98 (in Eng.).

19. Mameshina, M. (2016), "Condition of physical health of pupils of the 7th-8th classes of the comprehensive school", Slobozhanskyi herald of science and sport, Vol. 5 (55), pp. 47–52 (in Eng.).

20. Bala, T., Krivoruchko, N., Masliak, I., Stasyuk, R., Arieshyna, Y., Kuzmenko, I. (2018), "Influence of cheerleading classes on functional state of respiratory system of 10- 16 year old teenagers", Journal of Physical Education and Sport, Vol. 18 (4), pp. 1850–1855 (in Eng.).

21. Kolomiitseva, O., Prykhodko, I., Prikhodko, A., Anatskyi, R., Turchynov, A., Fushev, S., Hunbina, S., Garkavyi, O. (2020), "Efficiency of Physical Education of

University Students Based on the Motivation Choice of the CrossFit Program", Physical Activity Review, Vol. 8, pp. 26–38 (in Eng.).

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GENDER CHARACTERISTICS OF THE REACTION TO THE TRAINING LOAD OF ATHLETES SPECIALIZING IN HAND-TO-HAND COMBAT WITH PARTIAL CONTACT WITH THE OPPONENT

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Purpose: is to compare changes in the psychophysiological characteristics of male and female athletes with different levels of training under the influence of training load.

Material and methods: the study involved 66 athletes, 42 of them were male and 24 were female, with different levels of training. We determined psychodynamic characteristics in athletes before and after training load with the help of standard methods.

Results: we defined the dynamics of psychophysiological characteristics in athletes caused by training load. The trained athletes showed a state of mobilization evidenced by a significant decrease in strength and mobility of nervous processes.There were no reliable changes in male beginners engaged in hand-to-hand combat. The trained female athletes showed no significant differences in the indicators before and after training load, but the female beginners significantly decreased all psychodynamic characteristics.

Conclusions: the obtained data showed some gender differences in the reaction to the training load in athletes specializing in hand-to-hand combat with a semi-contact. The

training load led to the development of mobilization in trained athletes, while beginners of both sexes developed fatigue. There were no significant changes in the performance of the trained athletes.

Keywords: hand-to-hand combat, psychodynamic characteristics, genders peculiarities, risk predisposition.

Introduction

Hand-to-hand combat is an effective means of comprehensive physical and psychological development of modern youth. Hand-to-hand combat classes contribute to the formation of vital applied skills that provide appropriate training for young people, personnel in law enforcement agencies, the army, cadets and students of educational institutions specializing in certain areas [3,10,25].

Success in hand-to-hand combat requires athletes to have special physical qualities, which include strength and speed-strength training, speed of kicks and reaction to attacking actions of the enemy, special endurance and resistance to knocking movements, flexibility that ensures successful technical performance and techniques of hand-to-hand combat [5,10,25].

Most of these qualities depend not only on learning and training, but also on the functioning of body systems, such as the central nervous system, cardiovascular system, musculoskeletal system, vestibular system, etc. The peculiarities of the structure and functioning of these systems can promote success in hand-to-hand combat or limit the achievement of high results. In addition, the reaction of the athlete to the training or competitive load is important. In cases where the reaction is within the norm, the training process is adequate for the athlete's body [12,15,16]. If the training load causes unfavorable changes in the body systems that provide sports activities, it is necessary to work on changing training and rest regimes, or applying physical therapy to reduce the negative impact on the body of athletes and to achieve high results.

Assessment of the functional state of athletes is traditionally carried out with the help of indicators of the cardiovascular system [28], heart rate variability [2,16,24,30], central nervous system [1,5,11-14,19,33], vestibular [27,29] and other body systems. The biochemical characteristics of blood, urine, saliva [7,8,23] are also studied in the dynamics of the preparatory period and competitions.

Since not only men but also women are engaged in hand-to-hand combat with semi- contact with an opponent, the comparative assessment of reactions of athletes of different levels of training and different gerders to the training load is of considerable theoretical and practical interest. Training of men and women of each level in hand-to-hand combat takes place with the same load, regardless of gender. To prevent deterioration of functional state and overtraining, it is necessary to study the reactions of athletes to the test load taking into account their gender. This is especially true due to the current need to develop methods for predicting athletic performance and changing the functional state under the influence of training load.

The purpose of the work is to compare changes in the psychophysiological characteristics of male and female athletes with different levels of training under the influence of training load.

Material and Methods of the research

We observed 33 athletes specializing in hand-to-hand combat with semi-contact with an opponent (the 1st group included men (22 people) and the 3rd group included women (11 people). For comparison, we used the data of 33 athletes-beginners: 20 men (group 2) and 13 women (group 4). The age of all subjects was in the range of 18-23 years, which allowed to compare the results of the study.

The following psychophysiological characteristics were determined in all athletes before and after training load: functional mobility of nervous processes; strength of nervous processes, dynamics of nervous processes; time of simple visual-motor reaction; time of complex visual-motor reaction; anticipated time, delayed time, number of anticipated reactions, number of delayed reactions in determining the reaction to a moving object [1,4,6,15,18,19,24,32]. In addition, we determined the time of the spatial orientation and the spatial orientation speed. According to the

results of the proofreading test, the levels of attention and fatigue were assessed. They are characterized by the time of viewing the test tables, the pace of the test (the ratio of the number of viewed characters to the time of the test) and the number of errors. All indicators of the state of the central nervous system were determined by standard psychophysiological methods [4,15,18].

The risk predisposition assessment was carried in male and female athletes with different levels of training and results in sports using the methodology developed by Adamovich R. G. and Kochin O. V. [1].

The test training load in all groups of athletes lasted 90 minutes. The structure of the test training and the level of training load were developed taking into account the expert opinion of 30 specialists in hand-to-hand combat, according to the physical fitness of male and female athletes [21].

The study of psychophysiological characteristics was performed using a computer chronoreflexometer developed by the company "ASTER-IT" (Kharkiv, Ukraine).

Statistical processing of the obtained results was performed using descriptive statistics (with the determination of mean values and root mean square error). In case of significant variance in the indicators, we determined the medians (Me) and quartiles (25%; 75%). Evaluation of the reliability of differences between the indicators was performed using non-parametric criteria. We used the Mann-Whitney test for independent samples and Wilcoxon for dependent samples. The significance of the obtained results was determined at the level of 95%.

Results of the research

The results of the study of psychophysiological characteristics of male and female athletes are presented in tables 1 and 2.

Table 1

Average values of individual-typological characteristics of male and female athletes of different qualifications

Male athletes				
Characteristics	Groups			
	I (n=22)		II (n=20)	
	Before training	After training	Before training	After training

	load	load	load	load
Functional mobility of nervous processes (ms)	230,8±53,4	195,1±19,8* Z=2,5;p=0,01	247 (234;282)	214 (182;251)
Strength of nervous processes (ms)	360,1±55,6	320,0±37,7* Z=3,5;p=0,0005	380 (353;424)	359 (292;372)
Dynamics of nervous processes (c.u)	0,002±0,001	0,0013±0,001	0,0021 (0,0001;0,003)	0,0019 (0,0001; 0,003)
Number of anticipated / delayed reactions	0,8(0,1;1,5)	0,7 (0,4;1,0)	1.2 (0.5;1.2)	1,6 (0,4;1,2)
Female athletes				
Characteristics	Groups			
	III (n=11)		IV (n=13)	
Functional mobility of nervous processes (ms)	246,7±57,9	212,6±44,7	262 (246;290)	258(216;287)
Strength of nervous processes (ms)	406,1±74,7	343,6±73,4	422 (387; 519)	405 (359; 496)
Dynamics of nervous processes (c.u)	0,0013±0,001	0,0011±0,001	0,0023 (0,0001;0,0026)	0,0021 (0,0012; 0,0026)
Number of anticipated / delayed reactions	0,18 (0,11;0,96)	0,67 (0,38;1,22)	0,67 (0,25;1,2)	0,43(0,33;1,0)

Note: * - differences in the values of the indicator before and after loading are significant according to the Wilcoxon test

Table 2

Average values of psychodynamic characteristics of male and female athletes of different qualifications

Male athletes				
Characteristics	Groups			
	I (n=22)		II(n=20)	
	Before training load	After training load	Before training load	After training load
Time of the simple visual-motor reaction (ms)	268±39,2	254±31	262±20	254±38,9
Time of the complex simple visual-motor reaction (ms)	378±30,6	344±40,8	397±55,6	351.5±60,2
Moving object	116 (104;154)	89 (76;112)*	88 (60; 113)	115 (93;147)*

reaction time (ms)		Z=2,6;p=0,009		Z=2,1;p=0,03
Time of space orientation (ms)	15907 (12003;20496)	13225 (10150; 14990)* Z=2,1;p=0,03	16864 (14238;22537)	19748 (14916;23749)
Speed of space orientation (1/ms)X10^{-3}	1,3(1,0;1,7)	1,5 (1,3;2,0)	1,0 (0,7;1,3)	1,2 (0,9;1,4)
Number of anticipated / delayed reactions	3,5 (1,3;9)	1,9 (0,9;4,8)	1,9 (0,7;1,3)	1,5 (0,5;3,5)
Female athletes				
Characteristics	Groups			
	III (n=11)		IV (n=13)	
Time of the simple visual-motor reaction (ms)	288±13,7	278±26,6	282±13,8	264±8,4* Z=2,4;p=0,02
Time of the complex simple visual-motor reaction (ms)	430±31,9	374±30,1	429±50,7	403±44,3* Z=2.4;p=0.02
Moving object reaction time (ms)	98±29,5	96 ±28,6	163±47,1[1] U=7,5;p=0,005	126±33,8* Z=2,4;p=0,02
Time of space orientation (ms)	17010 (13764;24970)	16684 (8000;20202)	20800 (11969; 2183)	17402* (10269;20001) Z=2,4;p=0,02
Speed of space orientation (1/ms)X10-3	1,2 (0,8;1,5)	1.2 (1,0;3,0)	0.9 (0.9;1.7)	1,1 (1,0;2,0)* Z=2,4;p=0,02
Number of anticipated / delayed reactions	5,8(2,3; 9)	9 (3;19)[3] U=44,5; p=0,03	3 (1;4)[1] U=0,0;p=0,0005	0.4 (0,3;1,0)*[2] Z=2,4;p=0,02 U=0.0;p=0,0005

Notes: * - differences in the values of indicators before and after training load in the corresponding group are significant according to Wilcoxon's test; 1 - differences in values of indicators before training load between groups are reliable according to Mann-Whitney test, 2 - differences in values of indicators after training load between groups are reliable according to Mann-Whitney test; 3- differences in the values of indicators after exercise between men and women are significant according to the Mann-Whitney test.

The results of the proofreading test done by male and female athletes are presented in table 3.

Table 3

Average values of proofreading indicators of male and female athletes of different qualifications

Male athletes				
Indicators	Groups			
	I (n=22)		II (n=20)	
	Before training load	After training load	Before training load	After training load
Time for test passing, s	332 (309;399)	281 (262;340)* Z=2,7; p=0,0061	341 (315;371)	312 (290; 325)
Number of mistakes	10 (7;14,5)	6 (3.5;7)	8 (7;10)	5.5 (4; 7)
Rate , s^{-1}	1.5 (1,3;1,7)	1,8 (1,5; 1,9)	1,5 (1,4;1,6)	1,6 (1,6;1,8)
Female athletes				
Indicators	Groups			
	III (n=11)		IV (n=13)	
Time for test passing, s	271(252; 342)	269 (247; 316)	319 (294; 329)	297 (287; 319)
Number of mistakes	8 (6; 12)	13 (7; 20)	18 (10; 23)	20 (14; 33)* Z=2,36;p=0,017
Rate , s^{-1}	1,7±0,3	1,9±0,3	1,7±0,2	1,7±0,1

Note: * - differences in the values of the indicator before and after training load are significant according to the Wilcoxon test

The results of the risk predisposition assessment in male and female athletes of the studied groups are presented in table 4.

Table 4

Distribution of athletes of the studied groups according to risk predisposition, (%)

Male athletes				
Risk predisposition	Groups			
	I (n=22)		II (n=20)	
	before	after	before	after
low (0-0.33)	8 (38±10,3)	3 (12.5±7,2) [1] F=0,000965 χ^2=12,7	4 (21±9,1)[1] F=0,054237 χ^2=5,25	6 (30±12,1)
moderate (0.34-0.66)	12 (56±10,6)	16 (75±9.2)	13 (64±10.7)	13 (65±10.7)
high (0.67-1)	2(6,0±5,0)[1] F=0,005922 χ^2=9,31	3 (12,5±7,2) [1] F=0,000965 χ^2=12,7	3 (15±8,0)[1] F=0,018306 χ^2 =7,34	1 (5,0±4,5)[1] F=0,004424 χ^2=9,96
Female athletes				
Risk predisposition	Goups			
	III (n=11)		IV (n=13)	
low	5 (45±15)	6 (55±15)	2 (15.5±10)	4 (31±13)

(0-0.33)				
moderate (0.34-0.66)	5 (45±15)	3 (27±13)	9 (69±13)	9 (69±13)* F=0,099532 χ^2=4,2
high (0.67-1)	1 (10±9,0)	2 (18±12)	2 (15,5±10)	0

Note: 1- is the difference in the frequency of exposure to moderate risk and other degrees are significant (p <0,05); : *- the difference in the frequency of exposure to moderate risk after exercise between groups is significant.

Conclusions / Discussion

According to table 1, it can be noted that the average values of individual-typological characteristics of male athletes of different levels of training before and after exercise did not differ significantly. Athletes of the first group significantly decreased the characteristics of functional mobility of nervous processes and the strength of nervous processes, which indicates the development of mobilization. We detected no significant changes in performance after exercise in the second group. Individual-typological characteristics are quite stable and reflect the innate abilities of the central nervous system, so they little change under the influence of external factors [11,13]. The lack of significant differences between the groups of trained athletes and beginners indicated a slight influence of the level of training on the features of the typological organization of the central nervous system. This also applies to female athletes as we noted no significant effect on the value of their fitness and training load.

The parameter ‘number of anticipated / delayed reactions’ characterizes the balance of excitation and inhibition processes in the central nervous system. Its values (table 1) indicated the predominance of inhibition processes both before and after training in the studied groups of athletes. The processes of inhibition predominated in the first group athletes, and processes of excitation prevailed in the central nervous system of the second group athletes.

Psychodynamic indicators of athletes of different qualification levels were more sensitive to training load (table 2). Thus, the reaction time to a moving object and orientation time in space significantly decreased in the first group after training,

which confirms the development of the state of mobilization. The second group athletes developed the state of fatigue, which significantly increased the reaction time to the moving object. No significant differences were found between the groups before and after training.

There was a slightly different situation in groups of female athletes (table 2). We found no significant differences in the values of psychodynamic characteristics before and after training load in the group of trained athletes. In the fourth group, due to the load, all the studied indicators significantly decreased, except for the speed of orientation in space, which indicated the development of the state of mobilization. In the third group, the value of the ratio of the number of correct / incorrect answers indicates the intensification of excitation processes in the central nervous system. The fourth group showed the predominance of inhibition processes after training load. In addition, this parameter revealed significant differences between groups both before and after training load. The ratio 'the number of anticipated / delayed reactions' before training load indicated the predominance of excitation processes in the fourth group, although not such significant as in the third group, where there was an advantage of inhibition after training load. Simultaneous reduction of all studied indicators on the background of the inhibition process predominance may indicate the absence of a stable stereotype of the reaction to training load in athletes who have just been engaged in hand-to-hand combat. The training load offered to them caused the state of mobilization with the simultaneous development of the state of fatigue, which indicates the need to correct training.

Assessment of the level of attention and determination of the fatigue was performed using a proofreading test. Athletes of the first group significantly reduced the time of the test after training load on the background of maintaining its pace and quality, while the second group athletes did not experience significant changes in performance. Athletes of the fourth group significantly reduced the quality of the test, which is evidenced by the increase in the number of errors. This is another confirmation of the development of fatigue.

A professionally important quality of athletes who specialize in hand-to-hand combat is their predisposition for risky actions that provide an advantage over their opponents. The assessment of the risk predisposition (table 4) showed that most athletes had moderate predisposition, which was exacerbated by training load. Low and high risk predisposition are observed in significantly smaller percentage of cases. Most of the third group athletes revealed a tendency to low and moderate risk both before and after training load, while the fourth group athletes had mostly moderate risk ($\chi 2 = 3,85$; $F = 0,115238$) predisposition.

There is a considerable interest in comparing the values of the studied psychophysiological characteristics in trained athletes of both sexes (table 1 and 2). We did not find significant differences in the average values of individual-typological characteristics, but the dynamics of changes in indicators of male and female athletes differ (table 1). Thus, the parameter of functional mobility of nervous processes in men due to training load slightly decreased (by 6,9%) compared to baseline data. In women this parameter decreased by 25,5%, which shows a more pronounced reaction of mobilization. The strength of nervous processes also decreased in men much less than in women (11% and 24%, respectively). The indicator characterizing the dynamics of nervous processes increased in men by 54%, in women by 43% compared to baseline. Nervous processes, characterized by the ratio of the number of anticipated / delayed reactions, became more balanced in men (the ratio increased by 4,4 times) and did not change in women. For the most part, women underwent more noticeable changes under the influence of training load, which indicates their low resistance to training load.

When comparing psychodynamic characteristics, we found out that male and female athletes decreased the time of simple visual-motor reaction (male - by 7% and female - by 8,6%) due to training load (table 2). The time of complex visual-motor reaction in female athletes decreased by 8%; in male athletes it lowered by 12%. The decrease in the time of visual-motor reactions confirms the emergence of a state of mobilization in both men and women. Different direction of change is noteworthy in the characteristics ‘reaction time to a moving object’ and ‘orientation time in space’.

In male athletes, the reaction time to a moving object increased by 18% compared to the basaline data; in females this indicator decreased by 7%. On the other hand, the indicator of time orientation in space changed in the studied groups. It decreased by 6,5% in male athletes on the background of a significant ($Z = 2,1$; $p = 0,038$) increase in the number of errors when performing the test from ($4,5 \pm 2,1$) to ($7,1 \pm 3,1$), which indicates the development of fatigue together with mobilization. In female athletes, this indicator increased by 21% against a slight decrease in the number of errors from ($4,3 \pm 1,2$) to ($3,1 \pm 0,9$), which also indicates the development of fatigue. Significant differences between groups were revealed according to the number of correct / incorrect answers answers after training load. The dynamics of the parameter in male and female athletes is the same and indicates a decrease in excitation processes compared to the processes of inhibition. However, the severity of these changes is different. In males, the rate decreased due to training load by 40%, and in female athletes it lowered by 79%, which indicates more noticeable changes in the state of the central nervous system in females.

When comparing the distribution of athletes of both sexes according to the degree of risk predisposition (table 4), we can be see that before training load there were no significant differences between the groups. In both groups, the vast majority of athletes had low or moderate levels of risk predisposition. After training load, female athletes decreased the number of people with moderate risk predisposition and increased the number of people with low risk predisposition. In male athletes, on the contrary, there was a significant increase of people with moderate risk predisposition. Thus, the training load had different effect on the psychological state of athletes of both sexes.

The proofreading test results analysis (table 3) showed that there were no significant differences between groups of men and women. We can only note that the time of the test after training load did not change in female athletes, and significantly decreased by 15% in male athletes.

According to modern ideas, human psychophysiological characteristics are innate qualities and change slightly under the influence of training. Therefore, these

indicators can serve a reliable source of information about the state of the athlete's body. For example, the reaction rate is inherited on average by 80%, the speed of elementary movements - by 65%, hand coordination - by 45%, and joint mobility - by 65% [18,31].

Shinkaruk O. A. (2017) emphasizes the great importance in the process of long-term improvement of athletes taking into account their gender psychophysiological characteristics, which include reactivity of the nervous system, mobility of nervous processes, psychological stability, volitional and personal qualities [26].

The same opinion is shared by other authors, who point to the need to take into account the psychological and psychophysiological characteristics of athletes of different sexes during the organization of the training and competition process [12]. But most studies do not have specific recommendations for taking into account the gender of athletes during their psychological support.

Hand-to-hand combat is a sport that requires athletes to have purely masculine qualities, such as courage, toughness, strength, aggression in interaction with the opponent, and so on. Women who are professionally engaged in hand-to-hand combat should be brave, prone to risk, active, i.e. have masculine personality traits [20].

Martial arts are usually assessed as very masculine or insufficiently feminine in terms of gender stereotypes in relation to other sports [10].

Our analysis showed that in the modern literature the issues of training of women in hand-to-hand combat are insufficiently researched. There are only some works describing psychophysiological characteristics of women, as well as their change in training dynamics depending on the level of training [22]. In most cases, the results of the study of psychophysiological characteristics, features of the construction of the training process, model characteristics of men of different qualifications who specialize in hand-to-hand combat [17].

Thus, the novelty of the study is in identifying features of changes in psychophysiological characteristics of women of different levels of training, who

specialize in hand-to-hand combat with semi-contact with an opponent, and a comparative analysis of these changes in terms of gender.

Our research of psychophysiological reactions of male and female athletes with different levels of training allows drawing the following conclusions:

1. Comparison of individual-typological characteristics of trained athletes and beginners specializing in hand-to-hand combat did not reveal significant differences, indicating a slight effect of training on the typological organization of the central nervous system of men and women both before and after training load.

2. The inhibition processes dominated in athletes of different levels of training, while excitation processes prevailed in beginners which indicates different mechanisms of adaptation to training load.

3. The training load led to the development of mobilization in trained athletes, and fatigue – in beginners. We did not detect significant differences in the values of psychodynamic characteristics in the group of trained athletes before and after training load. The simultaneous decrease in all studied indicators in beginners on the background of the predominance of the inhibition process may indicate the absence of a stable stereotype of response to exercise, which caused a state of mobilization with the simultaneous development of fatigue.

4. The assessment of the risk predisposition of athletes showed that most of them had a moderate predisposition, which increased as a result of training load. Most trained athletes had a tendency to low and moderate risk both before and after training load but beginners had mostly moderate risk predisposition ($\chi 2 = 3.85$; $F = 0.115538$).

5. Comparison of individual-typological indicators of trained female and male athletes showed that as a result of training the indicator of functional mobility of nervous processes in men decreased by 7% compared to baseline data, and in women it decreased by 26%; the strength of nervous processes decreased in men by 11% , and in women it lowered by 24%; the ratio of the number of anticipated / delayed reactions increased by 4.4 times in male athletes and did not change in female

athletes. The obtained results indicated a more pronounced reaction to the training load in female athletes.

6. We did not reveal significant differences after training load in the number of anticipated / delayed reactions among trained athletes. The dynamics of the indicator in male and female athletes was the same and indicated a decrease in excitation processes compared to the processes of inhibition, but the degree of severity of these changes was different. The rate decreased due to the training load by 40% in male athletes, and by 79% in female athletes, which indicates more noticeable changes in the state of the central nervous system in women.

The prospect for further research is to identify gender characteristics of the response of functional systems of the body of athletes of different levels of training, specializing in hand-to-hand combat, training load and the development of individualized rehabilitation programs.

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References

1. Adamovich, R. G., Kochin, O. V. (2019), "Features of changes in psychophysiological characteristics of athletes engaged in hand-to-hand combat with full contact with the opponent under the influence of training load", Ukrainskyi zhurnal medytsyny, biolohii ta sportu, Vol. 4, No. 1, pp. 269-275. (in Ukr.)

2. Adamovich, R. G., Mayer, V. Ya., Minenko, O. V., Kurasa, G. O., Tvelina, A. A., Bila, A. A. (2018), "The results of the assessment of the functional state of athletes engaged in hand-to-hand combat with full contact by indicators of heart rate variability", Ukrainskyi zhurnal medytsyny, biolohii ta sportu, 3 (7), pp. 247-253. (in Ukr.)

3. Ananchenko, K. V., Pakulin, S. L. (2016), “Improving the sportsmanship of martial arts cadets of the National Academy of the National Guard of Ukraine”, Traiektoriia nauky, Vol. 2, No. 9, pp. 21-28. (in Ukr.)
4. Anastazi, A., Urbina, S. (2001), Psikhologicheskoe testirovanie [Psychological testing], SPb: Piter. 688 p. (in Russ.)
5. Ashkinazi, S. M., Klimov, K. V. (2006), Bazovaya tekhnika rukopashnogo boya kak sintez tekhniki sportivny`kh edinoborstv, ucheb.-metod. posobie [Basic technique of hand-to-hand combat as a synthesis of martial arts techniques]: ucheb.-metod. posobie, SPb: SPbGUFK im. P.F. Lesgafta, 80 p. (in Russ.)
6. Botyaev, V. L., Zagrevsky, O. I. (2009), “Psychomotor abilities of athletes to visual-spatial orientation and their relationship with visual-spatial perception”, Vestnik Tomskogo gosudarstvennogo universiteta, No. 5 (332), pp. 182-185. (in Russ.)
7. Volodchenko, O. A. (2018), Obhruntuvannia kompleksnoi metodyky prohnozuvannia zmahalni uspishnosti u kikboksinhu [Substantiation of complex methods of predicting competitive success in kickboxing]: avtoref.dys.kand nauk zi spetsialnosti 24.00.01 – olimpiiskyi i profesiinyi sport, Kharkiv. 22 p. (in Ukr.)
8. Gunina, L. M., Vinnichuk, Yu. D., Nosach, E. V. (2013), Biokhimicheskie kriterii utomleniya: metodicheskie rekomendaczii [Biochemical criteria of fatigue]: methodical recommendations, K .: Olympic Literature, 36p. (in Russ.)
9. Damadayeva, A. S. (2011), “Gender stereotypes about masculinity-femininity of athletes of different sexes”, Uchenyie zapiski universiteta im. P. F. Lesgafta, No. 8, pp. 67-71. (in Russ.)
10. Dykiy, O. (2016), “Military-sports all-around as an integral part of special physical training of conscripts”, Fizychne vykhovannia, sport i kultura zdorovia u suchasnomu suspilstvi, No 2, pp. 32-37. (in Ukr.)
11. Ilyin, E. P. (2005), Psikhofiziologiya sostoyanij cheloveka [Psychophysiology of human states], S-Pb .: Piter. 412 p. (in Russ.)
12. Korobeynikova, L. G. (2011), “Determinant of psychophysiological state in highly qualified athletes with different emotional characteristics”, Pedagogy,

Pedahohika, psykholohiia ta medyko-biolohichni problemy fizychnoho vykhovannia i sportu, No. 4, pp. 94-97. (in Ukr.)

13. Korobeynikova, L. G., Makarchuk, M. Yu., Korobeynikov, G. V., Mishchenko, V. S., Zapovitryana, O. B. (2016), "The state of psychophysiological functions of highly qualified athletes of different age groups", Fiziolohichnyi zhurnal, Vol. 62, No. 6, pp.81-87. (in Ukr.)

14. Makarenko, M. V., Lyzogub, V. S., Bezkopilny, O. P. (2004), "Neurodynamic properties of athletes of different qualifications and specializations", Aktualni problemy fizychnoi kultury i sportu : zbirka naukovykh prats, No. 4, pp. 105-109. (in Russ.)

15. Makarenko, M. V. (1999) "Methods of examinations and evaluation of individual neurodynamic properties of higher human nervous activity", Fiziolohichnyi zhurnal, Vol. 45, No. 4, pp. 125-131. (in Ukr.)

16. Pavlichenko, P.P., Popov, V.D. (2015) "Diagnostic methods of modern functional state of professional sportsmen in different conditions", Aktualni problemy suchasnoi medytsyny. Visnyk VDNZU «Ukrainska medychna stomatolohichna akademiia», Vol. 2(50), pp. 99-104. (in Ukr.)

17. Panov, P. P., Tropin, Y. M. (2019) "Model characteristics of physical fitness of qualified hand-to-hand athletes", Yedynoborstva, No. 3 (3), pp. 35-45. (in Ukr.)

18. Polevshchikov ,M. M., Dorogova, Yu. A., Rozhentsov, V. V. (2017), "Estimation of reaction to a moving object", Scientific & Educational Bulletin "Health and Education Millennium", [online] vol. 19, No 7. (in Ukr.)

19. Rovny, A. S. (2004) "Characteristics of sensory functions in athletes of different specializations", Slobozhanskyi naukovo-sportyvnyi visnyk : zb. nauk. pr., Kh., Vol. 7, pp. 224-229. (in Ukr.)

20. Sudakova, Yu. E. (2009) "Gender stereotypes in sports", Electronic scientific and educational journal of VSPU "Faces of Knowledge", No. 3 (4). Access mode: www.grani.vspu.ru (in Russ.)

21. Chernozub, A. A., Adamovich, R. G., Shtefiuk, I. K. (2019) "Scientific substantiation of the structure and content of the training load of athletes who

specialize in hand-to-hand combat", Ukrainskyi zhurnal medytsyny, biolohii ta sportu, Vol. 4, No. 5 (21), pp. 395-402. (in Ukr.)

22. Chernozub, A. A., Kochina, M. L., Chaban, I. O., Adamovich, R. G., Shtefyuk, I. K. (2017) "Improving the effectiveness of training and competitive activities of athletes who specialize in hand-to-hand combat, based on the use of individual psychophysiological characteristics", Ukrainskyi zhurnal medytsyny, biolohii ta sportu, No.6 (9), pp.69-74. (in Ukr.)

23. Chernozub, A. A., Titova, G. V., Dubachinsky, O. V., Slavityak, O. S. (2017) "Adaptive changes in the body of middle-aged women in terms of strength fitness", Visnyk Chernihivskoho natsionalnoho pedahohichnoho universytetu, Seriia: Pedahohichni nauky, Fizychne vykhovannia ta sport, 147 (1), P. 233-238. (in Ukr.)

24. Chernozub, A. A., Kochina, M. L., Chaban, I. O., Adamovich, R. G., Shtefyuk, I.K. (2018) "Results of assessment of psychophysiological characteristics of athletes engaged in hand-to-hand combat", Yedynoborstva, No.1 (7), pp.81-88. (in Ukr.)

25. Shillinford, R. (2002), Rukovodstvo po rukopashnomu boyu dlya speczpodrazdelenij [Guide to hand-to-hand combat for special forces], Translated from English by A. Kulikova, M. FAIR-PRESS, 352p. (in Russ.)

26. Shinkaruk, O. (2017) "Peculiarities of psychophysiological selection of athletes in the process of long-term improvement", Aktualni problemy fizychnoho vykhovannia ta metodyky sportyvnoho trenuvannia, Vinnytsia, No. 2, pp. 66-74. (in Ukr.)

27. Shtefiuk, I. K., Radchenko, Yu. A., Ermakova, A .O., Dovgan, O. V., Abramov, K. V., Brilov, A. A., Tkachenko, M .P. (2018) "The results of the assessment of the functional state of athletes who engaged in hand-to-hand combat with partial contact, in terms of heart rate variability and statodynamic stability", Ukrainskyi zhurnal medytsyny, biolohii ta sportu, Vol. 3, No.7 (16), pp. 283-288. (in Ukr.)

28. Borresen, J, Lambert, M. (2008), "Autonomic control of heart rate during and after exercise: measurements and implications for monitoring training status", Sports Med, 38, P. 633−646. (in Eng.)

29. Chernozub, A. A., Kochina, M. L. Kochin, O. V., Adamovich, R. G., Shtefiuk, I. K., Gorban, A. Ye. (2020), ”The Impact of Training Load on the State of the Vestibular System of Athletes specializing in Hand-to-Hand Combat”, Journal of Physical Education and Sport , Vol.20 (3), Art 222, P. 1628 – 1636. (in Eng.)
30. Choudhary, R., Triveti, V., Choudary, S. (2016) “Effect of heart rate variability biofeedback training on the performance of track athletes” International Journal of Therapies and Rehabilitation Research, 5(4), P.166–174. (in Eng.)
31. Eynon, N., Ruiz, J. R., Oliveira, J. et al. (2011). “Genes and elite athletes: A roadmap for future research”, J. Physiol, 589(13), P. 3063– 3070. (in Eng.)
32. Kuan, Y. M., Zuhairi, N. A., Manan, F. A., Knigh, V. F., Omar, R. (2018), “Visual reaction time and visual anticipation time between athletes and non-athletes”, Malaysian Journal of Public Health Medicine, Special Volume (1), P.135-141. (in Eng.)
33. Podrigalo, L., Iermakov, S., Potop, V., Romanenko, V., Boychenko, N., Rovnaya, O., et al. (2017) “Special aspects of psychophysiological reactions of different skillfulness athletes, practicing martial arts”, Journal of Physical Education and Sport, 17(2), P. 19-26. (in Eng.)

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DETERMINATION OF INDICATORS OF FEMALE ATHLETES' SPEED MOVEMENT ENGAGING IN ROWING

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Purpose: to determine the assessment criteria of speed abilities as indicators of the basis for the performance of female athletes' motor actions.

Materials and methods: the analysis of speed abilities of 13-18 years female athletes engaging in rowing during the modeled training and competitive activity is carried out according to the developed method, namely: rate, time and speed of single movement, movement frequency, sensor motor response to sound and light stimulus.

Results: the obtained results characterize the individual peculiarities of psychophysiological features of female athletes' organism in terms of modeling of sports activities, which makes it possible to make adjustments during the management of the training process.

Conclusions: based on the analysis of research results the assessment criteria of physical quality of speed and its components were developed: rate, time of single movement speed, movement frequency to determine the prospects of female athletes as one of the components of the selection methodology. The proposed technique is recommended to be used at different stages of improving sports training.

Keywords: female athletes, rowing, rate, time, single speed movement, movement frequency, time of sensor motor response to sound and light stimuli.

Introduction

Speed is a physical quality that is specifically manifested in various human motor actions. The speed of motor reaction is determined by fixing the time from light or auditory stimulation to the beginning of motor actions. Speed is primarily determined by nervous activity, which corrects movements. It largely depends on the perfection of sports equipment, muscle strength and elasticity, joints mobility [1].

The development of speed and speed-power qualities at school age is determined by the indicators of morpho-functional systems, which characterize the capabilities of an organism and close connection of functional systems with physical fitness [4, 5, 6].

Connection of the research with scientific programs, plans, topics. The research is carried out within the framework of the department theme of the research work "Biological bases (anatomical and morphological, physiological and biochemical) of optimization of the female athletes' training process in different sports and during physical education classes".

Purpose of the research: to develop the assessment criteria of speed abilities by rate of movements, time and speed of single movement, movement frequency, that ensures the performance of motor actions in certain conditions during a particular period of time.

Material and Methods of the research

The research carried out among female athletes of different ages specialize in rowing. The first group (21 people) - 13 - 14 years had the second sports category. The second group consisted of 20 people, aged 15-16 years, with the second and first level of sports qualification. The third group included 18 athletes, aged 17-18 years, who had the first category and Candidates for Masters of Sports of Ukraine.

The speed abilities of female athletes according to the developed method were studied [2, 3, 4, 7, 8]. Female athletes performed hand movements on a special stand

from target to target. During the first period of the test it was necessary to gain the maximum speed, duration of which was 15 s. The second period lasts 60 s. required maintaining the achieved speed. The speed endurance was studied in the third period, lasting 15 s., where the motor task was performed at the maximum speed. Sensory responses to light and sound stimuli were also studied.

Results of the research

Table 1 shows the time of sensory-motor response to sound stimulus. The time of female athletes aged 13-14 years is more by 0,012 s., i.e by 6,06% in comparison with 15-16 years and by 0,024 s. (11,43%) in comparison with female athletes aged 17-18 years.

Table 1

Indicators of physical quality of female athletes' movement speed engaged in rowing

Indicators		13 - 14 years			15 - 16 years			17-18 years		
		M ± m	Max.	Min.	M ± m	Max.	Min.	M ± m	Max	Min.
The first period	Rate (number of movements)	22,5±0,8	26	15	26,05±1,2	37	19	27,0±1,2	31	22
	Time of one movement	0,67	0,57	0,83	0,57	0,41	0,72	0,58	0,48	0,68
	Speed of one movement	0,44	0,52	0,36	0,52	0,74	0,42	0,54	0,62	0,44
	Frequency	1,48	1,73	1,20	1,73	2,47	1,27	1,80	2,07	1,47
The second period	Temp (number of movements)	25,5	33,7	29,05	29,0	32	23	30,5	37	25
	Time of one movement	0,53	0,44	0,66	0,51	0,46	0,65	0,50	0,40	0,60
	Speed of one movement	0,51	0,67	0,43	0,58	0,63	0,47	0,60	0,74	0,50
	Frequency	1,71	2,25	1,47	1,53	2,13	1,53	2,0	2,47	1,68

The response to the light signal in the younger group was more by 0,042 s. (19,35%), in comparison with female athletes in the middle group and by 0,056 s. (16,5%) than in the senior.

In determining the trained effect in the first period in the group of female athletes aged 13-14 years, the rate was lower by 3,7 movements (16,59%) than in

athletes aged 15-16 years, and by 4,7 movements (21,08%) of 17-18 years. The last group showed an increase in pace per movement (3,85%).

The results characterize the unequal reaction of female athletes of all ages, especially in 15-16 years age group, as well as different levels of sports training in all female athletes, especially of 13-14 and 17-18 years.

The time of one movement of female athletes aged 13 -14 years increased by 0,09 s. (16,67%) than in female athletes aged 15-16 years old and by 0,117 s. (21,08%) in contrast to 17-18 year old. Thus, the time of one movement [1, 5] from the younger to the older group decreases, that characterizes the improvement of one of the speed indicators.

The movement frequency of female athletes increases with age. The movement frequency of female athletes aged 15 - 16 years was higher by 0,25 Hz (16,89%) and in 17 -18 years girls by 0,35 Hz (21,62%) than in 13 - 14 years, and in female athletes of 17 -18 years this indicator was more than in 15-16 years by 0,07 Hz (4,05%). In the younger group the maximum frequency was higher than the average value - 0,25 Hz (16,89%), and the minimum - less than the average by 0,28 Hz (23,33%). The highest movement frequency increased by 0,74 times (42,77%) in the middle group of female athletes. In the older group the best indicator was higher than the average by 0,27 Hz (15,22%).

In the second period of the research test in female athletes of 13-14 years, the rate improved less than in female athletes of 15-16 years aged group by 3,5 movements (13,73%). The difference in rate indicators between the maximum and the minimum average results were observed in female athletes of 13 - 14 years age group by 48,26%, 15 - 16 years old - by 36,43%, 17 - 18 years old by 43,33%.

The movement frequency in 13 - 14 years age female athletes' group compared with 15 - 16 years age group is lower by 0,22 Hz (12,87%) and compared with 17 - female athletes of 18 years age group by 0,29 Hz (16,96%).

In the third period of the test the lowest rate in female athletes of 13 - 14 years age group was observed, in 15 - 16 years age female athletes' group by 3,1 movements (11,31%) and in 17 - 18 years by 41,2 movements (13,3 %).

The time of one movement in 13 - 14 years age female athletes' group was more than in 15 - 16 years by 0.56 s. (11,4%), and in the female athletes of the senior group this figure decreased by 0.02 s. (4,25%). The speed of one movement in 13 - 14 years female athletes was lower in contrast with the 15 - 16 year age female athletes' group by 0,062 m/s (11,3%) and lower than in the 17 - 18 year age female athletes' group by 0,088 m / s (16,09%).

The movement frequency in female athletes aged 13-14 years was lower than in 15-16 years by 0,21 Hz (11,56%) and by 0,30 Hz (16,48%) in 17-18 years.

According to the total test indicator the efficiency has the following characteristics. The rate was less in female athletes of 13 - 14 years than in 15 - 16 years by 3,3 movements (13,04%) and lower than in 17 - 18 years female athletes by one movement (3,49%). Female athletes of the first group have the best result that was higher than the average by 7,3 movements (28,85%). The female athletes of the second group have the highest rate that was higher than the average by 12 movements (41,96%) and the lowest average by 6 movements (26,55 %). The athletes of the third group have the highest result that was higher than the average by 6,2 movements (20,65%) and the lowest was lower than the average by 4.8 movements (19,35%). The difference in the total result of the rate between the maximum and minimum compared with the average index was more than by 44,91% in 13 - 14 years, in 15 - 16 years - 68,51% and in 17-18 year - by 40,3%. The time of one movement in the first group was more than by 0,009 (13,91%) in the second group, and in comparison with the third one by 0,018 s. (35,6%). At the age of 13 – 14years the indicator decreased by 0,132s. (28,69 %).

The speed of one movement in female athletes of 13 - 14 years is less than in 15 – 16 years by 0,067 m/s (13,24%) and than in 17 - 18 years by 0,088 m/s (17,39%), and in 15 - 16 years less than 17 - 18 years by 0,021 m/s (3,67%).

In the younger group the total maximum speed is higher than the average by 0.12 m/s (28,85%), the minimum - less by 0.069 m/s (15,79%). In the middle group the deviation is accordingly by 0.244 m/s (42,58%). In the older group the best result is higher than the average by 0.129 m/s (21,79%), the worst result is lower by 0.094

m/s (18,8%). Deviations of the speed of one movement according to the best and lowest results were: in female athletes of 13 - 14 years - 44,64%, in 15 - 16 years- 68,37%, and in 17 - 18 years - 41,73%.

The obtained results characterize the individual characteristics of female athletes in terms of modeling sports activities, reflect different reactions and, thus, different levels of sports qualifications [2, 5, 6, 7].

Table 2 shows the criteria for assessing the quality of speed in the group of female athletes aged 13 - 14 years engaged in rowing. In the third period these results characterize the level of physical and functional condition of the studied female athletes. The average time of sensor motor response to sound is rated as "good".

Table 2

Indicators of physical quality of female athletes' movement speed engaged in rowing

Indicators		13 - 14 years			15 - 16 years			17-18 years		
		M ± m	Max.	Min.	M ± m	Max.	Min.	M ± m	Max.	Min.
Third period	Rate (number of movements)	27,4	35	22	30,5	44	24	31,8	36	27
	Time of one movement	0,54	0,42	0,68	0,49	0,34	0,62	0,47	0,41	0,55
	Speed of one movement	0,54	0,69	0,43	0,61	0,37	0,48	0,63	0,71	0,55
	Frequency of movement	1,82	2,33	1,47	2,03	2,03	16	2,12	2,4	1,8

The average movement rate is evaluated as "good", the best indicator is as "excellent", and the worst – as "satisfactory". The time of one movement is evaluated at the level of "good".

The speed of one movement is mainly at the level of "good" and the maximum speed is at the level of "excellent".

In the second period of the test the female athletes maintain the rate of movement as "excellent" (20,59%), and the minimum evaluation is "satisfactory".

The speed of one movement is on average at the level of "good" and the movement frequency is also at the level of "good".

In the third period of the test the rate of movement exceeded the evaluation "good" by 0,4 (1,48%). The time of one movement took place mainly at the level of "good". The best indicator was at the level of "excellent", and the worst result was not equal to the evaluation "satisfactory" (24,68%). The average speed of one movement reaches the evaluation "good". The average frequency of movements is equal to the evaluation "good", and the maximum is equal to the evaluation "excellent".

According to the total indicator of the test in female athletes 13 - 14 years, the rate of movements is at the level of "good". Time of one movement is at the level of "good". The average frequency of movements is at the level of "good".

The obtained research results of female athletes of 15 – 16 years engaged in rowing allowed to develop the assessment criteria of quality of speed of some of its components, which are presented in table 3.

The time of sensor motor response to sound was equal on average the evaluation "good". The best result was higher than the evaluation "excellent" by 0,028s. (18,42%), and the lowest result is at the evaluation of "satisfactory" by 0,014s. (6,22%). The time of motor reaction to light was on average equal to the evaluation of "good", and the lowest result was less than the evaluation of "satisfactory" by 0,012s. (5,11%).

In the second period of the test the average movement rate was at the level of "excellent", and the maximum result of the movement was higher than "excellent" (4,91%) by 1,5%, and the minimum at the level of "satisfactory". In the third period of the test the rate of movement was equal to the evaluation "good".

In the third period of the test the rate of movement was at the level of "good", and the speed of one movement was on average at the level of "excellent" - 0,199 m/s. The total test score for female athlete of 15 - 16 years engaged in rowing had the following indicators: the rate of movement –"good", and the worst evaluated as "satisfactory". The speed of one movement had evaluation "good".

The big difference between the maximum and minimum indicators was established on the basis of the carried out research that is testified by an unequal level of physical and functional preparation of female athlete of the named group.

The assessment criteria of speed of female athlete of 17 - 18 years are given in table 2.

In the first period of the test the rate of movement evaluated as "good". The best indicator was equal to evaluation "excellent", and the lowest - "satisfactory". In the second period of the test the evaluations of movement indicators were as follows: rate - evaluation "good", time of one movement – evaluation "good".

In the third period, the rate of movement was lower by 0,63% than the evaluation "excellent", the time and speed of one movement on average evaluated as "good".

Thus, the results of the research determine quite comparable level of speed quality. The increase in the level of speed of arbitrary movements is due to the training of speed in integral movement, as well as a number of factors that determine the maximum speed when performing holistic exercises. Of great importance for achieving maximum speed is the desire to achieve maximum speed. Simple motor response is determined by two main components: the latent period and motor ability, which is improved during the training.

Conclusions / Discussion.

The analysis of scientific and methodical literature showed, that for the improvement of methods of the development of motor qualities and the formation of movement speed, the definition of age periods has the greatest value. It is proved that the influence of training changes the rate, time, movement frequency, time of sensor motor reactions to sound and light stimuli. Speed indicators characterize the individual psycho-functional features of the female athletes' body, which makes it possible to make adjustments in the improvement and effective management of the training process. On the basis of comparative analysis the assessment criteria of quality indicators, speed in regard to the definition of prospective female athletes are developed at various stages of sports preparation.

Prospects for further research are to study the relationship of the development of special physical qualities characteristics of athletes in different sports. It is recommended, along with the study of traditional indicators, during the prediction of sports abilities, to identify other functional and psycho-physiological indicators that change under the influence of training.

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References

1. Korsun, S. M., Shaposhnikova, I. I., Suvorova, Ya. V. (2012), Biokhimichna kharakterystyka riznykh vydiv sportu [Biochemical characteristics of different sports]: navchalnyi posibnyk, Kharkiv, 130 p. (in Ukr.)
2. Kostiukevych, V. M., Shynkaruk, O. A., Voronova, V. I., Borysova, O. V. (2019), Osnovy naukovo-doslidnoi roboty zdobuvachiv vyshchoi osvity zi spetsialnosti "Fizychna kultura i sport" [Fundamentals of research work of higher education students majoring in "Physical Culture and Sports"], Kyiv: Olimpiiska literatura, 613 p. (in Ukr.)
3. Platonov, V. N. (2010), Plavanie [Swimming], Kiev: Olimpijskaja literatura, 496 p. (in Russ.)
4. Platonov, V. N. (2015), Sistema podgotovki sportsmenov v olimpijskom sporte: obshhaja teorija i ee prakticheskie prilozhenija [The system of training athletes in Olympic sports: general theory and its practical applications]: uchebnik, Kiev: Olimpijskaja literatura, 680 p. (in Russ.)
5. Serhiienko, L. P. (2001), Kompleksne testuvannia rukhovykh zdibnostei liudyny [Comprehensive testing of human motor abilities], Mykolaiv: UDMTU, 360 p. (in Ukr.)
6. Shynkaruk, O. A., Lysenko, O. M., Hunina, L. M. (2009), Medyko-biolohichne zabezpechennia pidhotovky sportsmeniv zbirnykh komand Ukrainy z olimpiiskykh

vydiv sportu [Medical and biological support for the training of athletes of the national teams of Ukraine in Olympic sports]: navchalnyi posibnyk, Kyiv: Olimpiiska literatura, 144 p. (in Ukr.)

7. Shynkaruk, O. A. (2004), "Substantiation of the use of physiological indicators as criteria for selection of athletes in cyclic sports", Aktualni problemy fizychnoi kultury i sportu : zb. nauk. pr., Kyiv. NUFVSU, pp. 54-57 (in Ukr.)

8. Shkrebtii, Yu. M. (2005), Upravlinnia trenuvalnymy ta zmahalnymy navantazhenniamy sportsmeniv vysokoho klasu [Management of training and competitive loads of high-class athletes], Kyiv: NUFVSU, pp. 349-394. (in Ukr.)

9. Reinhard, P. A., Gerson, E. A.M., Sheel, A. W. et al. (2020), "Quantifying the mechanical work of breathing in men and women during rowing", Eur J Appl Physiol No. 120 (2)**,** pp. 381–390, DOI: 10.1007/s00421-019-04282-8 (in Eng.)

10. Idan Harat, Nicolas W. Clark, Boffey D., Chad H. Herring, Erica R. Goldstein, Michael J. Redd, Adam J. Wells, Jeffrey R. Stout & David H. Fukuda (2020), "Dynamic post-activation potentiation protocol improves rowing performance in experienced female rowers", Journal of Sports Sciences, DOI: 10.1080/02640414.2020.1754110 (in Eng.)

11. Jason R., Suzanne T., Leaf P., Leaf B. (2020), "Understanding the Unique Psychological Demands of Competitive Collegiate Rowing: A Guide for Practitioners", Journal of Sport Psychology in Action, DOI: 10.1080/21520704.2020.1770908 (in Eng.)

12. Yang Liu, Binghong Gao, Jiru Li, Zuchang Ma, Yining Sun (2020), "Increased foot-stretcher height improves rowing performance: evidence from biomechanical perspectives on water", Sports Biomechanics, No. 19 (2), pp. 168-179, DOI: 10.1080/14763141.2018.1453540 (in Eng.)

13. John Warmenhoven, Stephen Cobley, Conny Draper, Andrew Harrison, Norma Bargary & Richard Smith (2019), "Considerations for the use of functional principal components analysis in sports biomechanics: examples from on-water rowing", Sports Biomechanics, No. 18(3), pp. 317-341, DOI: 10.1080/14763141.2017.1392594 (in Eng.)

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MODERN METHODS FOR ASSESSING THE COMPLEXITY OF MOTOR ACTIVITY AND ITS QUALITATIVE PERFORMANCE

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Purpose: a single method justification for assessing the complexity of motor activity and quality of its performance.

Materials and methods: the carried out researches used empirical materials of dissertation works and research in the field of sports and physical culture, in which various methods for qualitative assessment of performed movements and definition of its complexity category were used.

Results: general provisions, which are the basis of motor activity formation, its objectification in subsequent periods of physical development, principles of ranking the complexity of motor activity construction, criteria of constructing the individual algorithm of training and formation of optimal group compatibility in game types of motor activity organization, are established**.**

Conclusions: introduction of the unified system of certification and systematization of physical development of the population of Ukraine will allow maintaining the sufficiently complete and meaningful information about the labor potential of the country and to distribute more expedient its provision of state needs.

Keywords: biomechanical analysis, complexity assessment of motor activity, rank of training, motor talent.

Introduction

The problem of objectivity for assessing the performance of competitive exercises is inherent for any kinds of sport and professional work. Its solution is possible on the basis of strict theoretical validity of construction of complex-coordinated motor activity and available level of development of consistently complicated kinematics of movements during many years of training.

The natural form of development and movement learning begins with the postnatal period. Their consistent objectification at each stage has its own characteristics. Accounting these features is necessary for the construction of an individual passport of physical development and the level of readiness available for a particular person. The uneven flow of physical development leads to the release of puberty and sensational periods, in which it's essential to take into account the availability of physical activity both in its structural complexity and volume.

The scheme of age periodization, adopted at the VII All-Union Conference on Age Morphology, Physiology and Biochemistry in 1965, is most often used in domestic medical and biological research. It is represented by the following time periods: newborn 1-10 days; infant age 10 days-1 year; earlier childhood 1-3 years; first childhood 4-7 years; second childhood 8-12 years (boys), 8-11 years (girls); adolescence 13-16 years (boys), 12-15 years (girls); youth age 17-21 years (boys), 16-20 years (girls); I mature age 22-35 years (male), 21-35 years (female); II mature age 36-60 years (male), 36-55 years (female); advanced age 61-74 years (men), 56-74 years (women); senile age 75-90 years; centenarians - 90 years [1, 2].

This chronological periodization has its distribution density by body weight growth indicators and its formation into individual systematic constitution. This provision defines leading, normally and low developing individuals. They have body proportions corresponding to normal chronological development by their constitution. Regarding the category of normal structure of development, there is a category of deviating individuals by the ratio of mass growth and its formation. These deviations are manifested in the changed proportions of bio-kinematic links of body, which determines the peculiarities of their movement dynamics and energy consumption for providing these locomotions [3].

The statistical principle of morphofunctional organization of the developing organism taking into account physiological features ensuring mass growth and its formation of the given scheme of age periodization allows distributing into seven levels of its rank improvement [4]. This provision has a mathematical basis based on the general principles of self-organization of developing systems [5]. The foundation of this provision is based on the developed construction methods of sign semantic spaces in KhSAPC with the introduced in them a single comparison measure of mutual conditions of relations of mass-forming masses of the flowing organogenesis [6].

The purpose of the research is a single method justification for assessing the complexity of motor activity and quality of its performance.

Material and methods of the research

Materials and methods of research: analysis and generalization of empirical data, clinical anthropometry, biomechanical methods for assessing the motion construction, method of orderly presentation of empirical data of sign semantic spaces with introduced in them a single measure of sigmal measurements of compared signs, speed video shooting, and computer processing of obtained video material.

Results of the research

There are average indicators of chronologically normally developing individuals in each of the age periodization of age morphology, physiology and

biochemistry. Such indicators are characteristic of a particular population. Within the population norm of chronological age, one can talk about a regional chronological norm, which consists of a set of individual norms. There is a coincidence between the chronological average norm and the individual norm in each of the defined norms.

The individual norm reflects the peculiarities of biological development and is characterized by biological age with morphofunctional characteristics of the course of metabolic processes and somatotype constitution. In characteristic semantic spaces the individual norm is characterized by a vector coming from the origin of coordinates and connecting it to the location of the individual norm in the characteristic semantic space. Thus, the individual norm is characterized by the vector length and the angle of its deviation from the line of chronological norm of development.

Nine zones in the direction of deviation from the norm of chronological development and three levels of deviation are allocated in this semantic space, in accordance with the normal law of distribution density of the controlled contingent that is shown in Fig.1

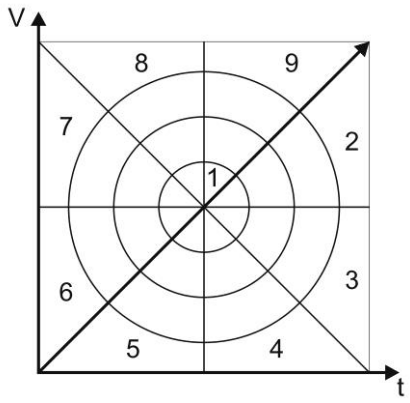

Fig.1. Type classification of individual norms

“Body size is time of its achievement” in the sign semantic space (description in the text).

In fact, this characteristic is represented by a three-dimensional space divided into three coordinate planes, which reflect the distribution of masses in three directions: body length, body width and anteroposterior (thickness) body. In a deeper

classification of body structure, which is extremely important for the evaluation of body motion kinematics, clinical anthropometry was used according to the method of M.M. Breitman in her modified version, developed in KhSAPC [7] and presented as the logarithmic spiral, where the norm is the circle, in which each of 15 measured parts of the body are arranged in order of their weight value.

Only linear dimensions of length of the considered body parts are given in the Figure 2. In reality, a complete representation is presented in a three-dimensional "unit" cube or "unit" sphere.

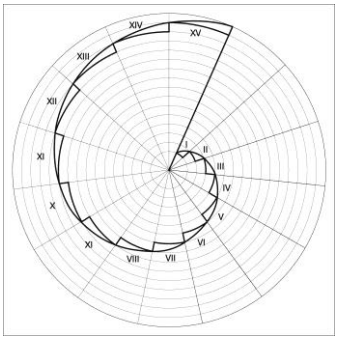

Fig.2. Human anthropometric parameters in the polar coordinate system

The "muscle" type of physique presented by M.M. Breitman is taken as an example.

Similarly, the share of physical qualities in construction of the performed movements is presented (Fig. 3 (c, b, a)

It is necessary to have standard tests for the evaluation of motor qualities and standard arsenals characteristic and accessible motor activities in each of the age periods in all cases in order to carry out this type of certification. This is due to the fact that a more complex combination of movements' construction is formed with narrower specialization of their use on the basis of the previous learned arsenal of movements by making them possible. If we compare the structure of improvement and development of narrow professional motor activity as some meta-language, this process corresponds to the full complication of the development of language movement from household forms of motor activity to their substantive orientation types of sports specialization with the subsequent narrowly directed specialization of

meta-language, reaching the highest level of its manifestation, expressed in the pedestal of the Olympic Champion or the World Champion.

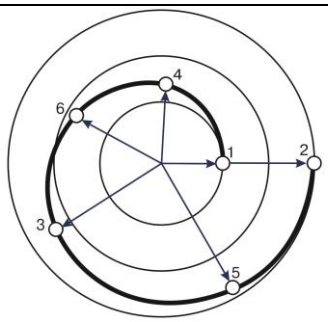	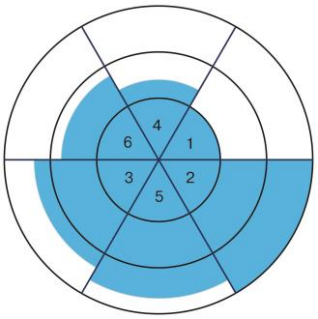	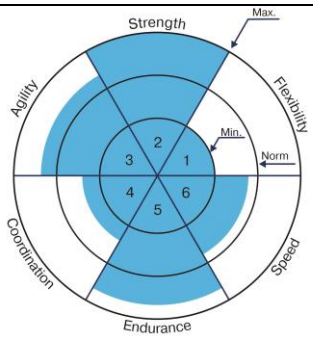
c	B	a
Distribution of consecutive physical qualities in the logarithmic helix. The value of min and max is located on the same radius of the vector. Their location defines a single turn of the logarithmic helix. The location of the rest is determined by their rotation until the moment of logarithmic spiral touches.	Distribution of these qualities in the order in which they are changed.	Average circle reflects average norm of motor properties in the used standard tests.

Fig. 3. Partial manifestation of physical qualities in construction of the executed movements of the corresponding standard tests

The mathematic of this process is described by exponential dependence. It can be expressed in the coordinate system where ordinate is represented by a scale “level of achievement” or “available complexity” and “rank of achievement”. Such a scale is formed by the normal law of density distribution of probable availability of task complexity execution, which includes force of expression of the performed actions, their duration and multi-componence of content simultaneously or sequentially performed actions. The sigmal distribution of task complexity has six complicated zones corresponding to the verbal description: imitation or copying (plagiarism); eclecticism or collecting; compilation or combination, association; skill-knowledge of various options for solving the problem; creativity-ability to create new; creation or motor genius - unreachable creation.

Six zones have seven boundary sections from the initial public or zero level of complexity and the limit seventh rank of creation. In a summarized table expression of this representation the motor task performance can be represented as a rectangular matrix in which each column contains elements of equal complexity relating to the considered kind of sport.

Each row contains elements of all seven complexity categories distributed in the sequence of the column sequence number.

The column number determines the element complexity in the row.

The element, which is present in each cell, has its own number, in which the first digit indicates the line number ($a_{1,1}; a_{1,2}; a_{1,3} ... a_{1,n-1}; a_{n,n}$).

The element complexity in a string grows by logarithmic dependence and consists of the following components:

1. Complexity (number of elements) is the part (S)

2. Severity (effort quantification) is the part (F)

3. Duration is the part (t).

These are making difficulty of the performed work in overcoming each of seven ranks. The measure of climbing difficulty is represented by the sum of quantitative indicators of elements of overcome difficulties A=(S+F+t). The complexity premium is determined by accuracy measure, which is expressed in inverse proportion to the mean square deviation $\delta : h = \frac{1}{\delta\sqrt{2}}$. The term “accuracy measure” is derived from measurement error theory [9,10,11].

The generalized Fig. 4 representing the meaningful content of the overcome complexity way to the limit of available rise to the top of the seventh rank ascent.

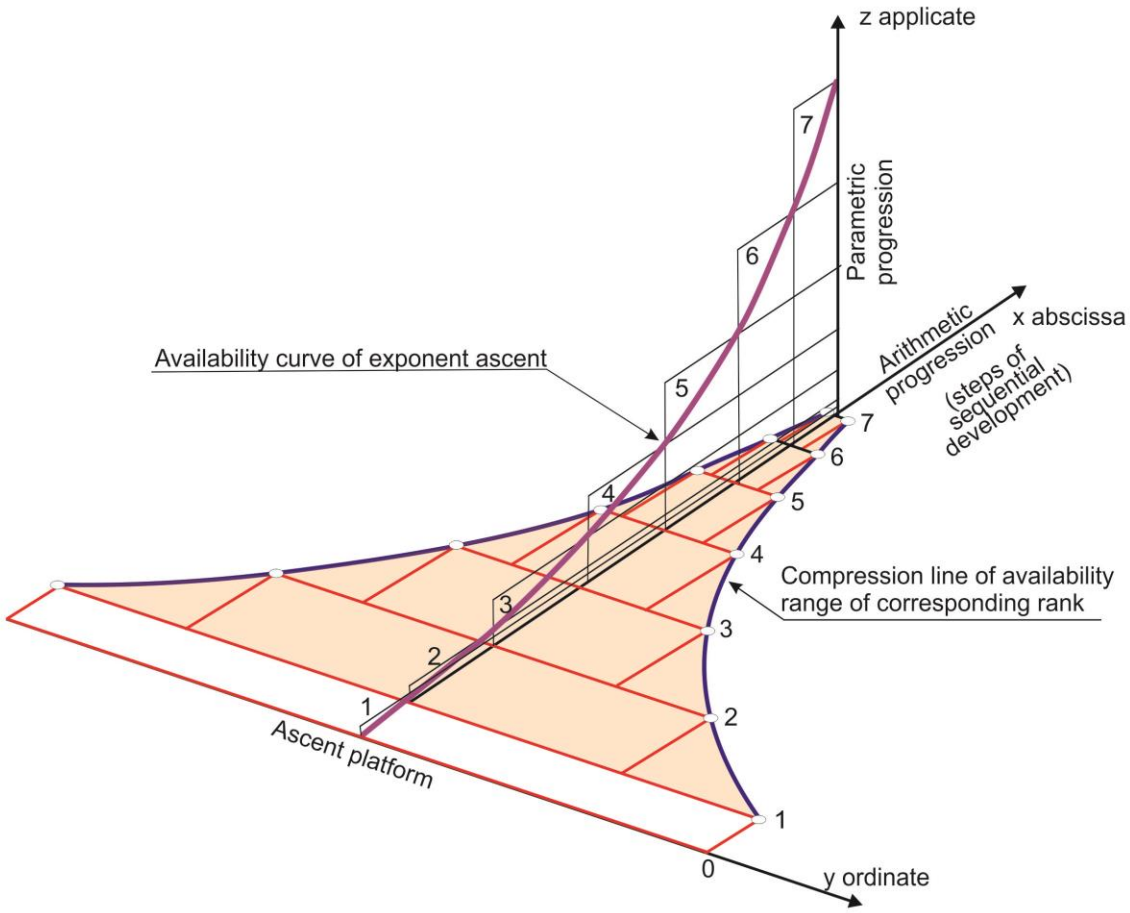

Fig. 4. Representation of meaningful content of the overcome complexity way to the limit of available rise to the top of the seventh rank ascent.

The construction details of the generalized three-dimensional representation of the increasing complexity of specialized motor activity are presented in Fig. 5.

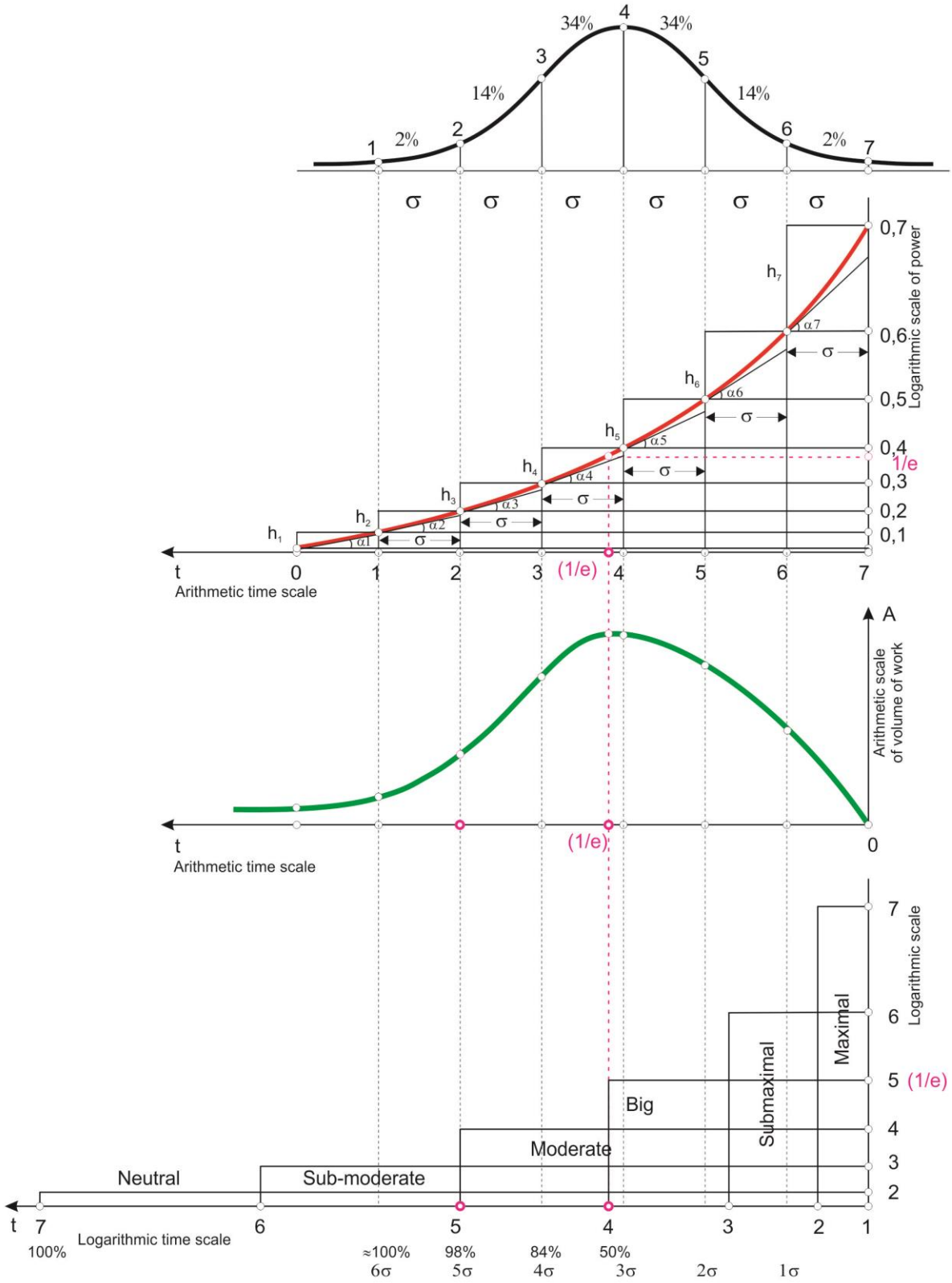

Fig. 5. Components of the growing complexity of specialized motor activity: a) logarithmic scale of power representation $tg\alpha_i = \frac{h_i}{\delta}$ $h_i = tg\alpha \cdot \delta$; $S_i = \frac{\delta \cdot h_i}{2} = A$; $N = \frac{A}{t}$; $N = \frac{\delta \cdot h_i}{2} : t = \frac{\delta \cdot h_i}{2 \cdot t}$. h_i - geometrical progression; t - arithmetic progression

The obtained analytical descriptions of the complexity assessment of motor activity and qualitative performance taking into account the premium for the category of complexity were made for the development of the automated system ensuring objectivity of judging, first of all, in sports, in which the result of performance is estimated in points.

The method of remote assessment in real time is based on high-speed shooting and its computer processing, which is an integral part of such system, isn't presented in this article, because it has a deep coverage in previous publications published in Slobozhanskiy herald of science and sport [7,8].

Conclusions / Discussion

The presented system of complexity assessment of motor activity and its qualitative implementation taking into account allowances for complexity and measure of accuracy can be used in almost any sphere of sports and professional activity. Its introduction into practice allows developing a unified system of individual certification and systematization of physical development and level of physical preparation of the controlled contingent.

In the practice of sport this approach makes it possible to identify the most exposed individuals to the exact specificity of motor activity due to the corresponding phylogenetic talent. The development of a unified system of certification and systematization of physical development and level of physical preparation should be carried out at all stages of age periodization which is used in the practice of medical and biological research.

Prospects for further research in this direction. The further development of this direction will be connected with practical implementation of a full-scale complex of remote assessment in real time of the current functional state according to the observed kinematics of movements of the controlled individual with the complexity assessment of motor activity and quality of its performance, and also allowances for the rank of complexity and accuracy of the final result.

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References

1. Azhippo, A. Y., Shesterova, L. Y., Druz, V. A., Dorofeieva, T. I., Pugach, Y. I., Piatisotskaya, S. S., Zhernovnikova, Y. V. (2016), Ontologiya teorii konstitutsionalnoy diagnostiki fizicheskogo razvitiya i individualnyih osobennostey proyavleniya biologicheskogo vozrasta [Ontology of the theory of constitutional diagnostics of physical development and individual features of biological age manifestation]: monografiya. Harkov: HGAFK, 284 p. : monograph. Kharkov: KhSAPC, 284 pp. (in Russ).

2. Artemiev, V. A., Druz, V. A., Iefremenko, A. (2020), "Methods of contactless remote determination of sportsman's current functional state", Slobozhanskyi naukovo-sportyvnyi visnyk, № 1 (75), pp. 86-92 (in Russ).

3. Balsevich, V. K. (2009), Ocherki po vozrastnoy kineziologii cheloveka [Essays on human age kinesiology], Moskva: Sovetskiy sport, 220 p. (in Russ).

4. Batieieva, N. P., Kyzim, P. N. (2017), Sovershenstvovanie spetsialnoy fizicheskoy i tehnicheskoy podgotovki kvalifitsirovannyih sportsmenov v akrobaticheskom rok-n-rolle v godichnom makrotsikle [Improvement of special physical and technical training of qualified sportsmen in acrobat rock and roll in an annual macro cycle]: monografiya, HarkIv: FOP BrovIn O.V., 228 p. (in Russ).

5. Ventsel, Y. S. (1969), Teoriya veroyatnostey [Probability theory], Moskva, pp.119-120 (in Russ).

6. Druz, V. A., Dorofeieva, T. I., Dzhim, V. Y. (2014), Vliyanie emotsionalnogo sostoyaniya na vyipolnenie dvigatelnoy deyatelnosti v ekstremalnyih usloviyah ee protekaniya [Impact of emotional state on performance of motor activity in extreme conditions of its flow]: uchebnoe posobie, Harkov: HDAFK, 305 p. (in Russ).

7. Kyzim, P. M. (2018), Biomekhanika v akrobatychnomu rok-n-roli [Biomechanical in acrobat rock and roll]: navch.-posib, Kharkiv.: FOP Brovin O.V., 130 p. (in Ukr).

8. Revenko, V., Pugach, Y., Druz, V., Artemiev, V. (2019), "Modern methods of monitoring and assessment of current functional state of sportsmen in different types of single combats", Slobozhanskyi naukovo-sportyvnyi visnyk, № 6 (74) pp. 57-62 (in Russ).
9. Samsonkin, V. N., Druz, V. A., Fedorovych, Y. S. (2010), Modelirovanie v samoorganizuyuschihsya sistemah [Modeling in self-organizing systems]. Donetsk, 104 p. (in Russ).
10. Khrisanfova, Y. I., Perevosnikov, I. V. (1991), Antropologiya [Anthropology], Moskva: MGU. pp. 105-106 (in Russ).
11. Gagey, P.-M., Ouaknine, M., Sasaki, O. (2002), "Pour manifester la dinamique de la stabilization", Posture et équelibre. Neuveautés 2001, conceptuelles, istrumentales et cliniques, Lacour M., Solal, Marseille, pp. 73-79. (in Eng).
12. Kenney, L. W., Wilmore, J. H., Costii, D. L. (2012), "Physiology of sport and exercise Champaign", Human Kinetics, 621 p. (in Eng).
13. Puhach, Y. (2020), "Modern methods of determination for individual norm of volumes and intensity of performing motive activity", Слобожанський науково-спортивний вісник, № 1 (75), С. 93-97 (in Eng).
14. Sarabon, N. (2012), Balance and Stability Training, NSCA, Guide to Program Design. Editor Jay R. Hoffman, Human Kinetics, pp. 185 – 212 (in Eng).
15. Schnabel, G. (1994), "Prinzipien des sportlichen", Trainingswissenschaft, Sport Verbag, Berlin, pp. 282-294 (in Eng).
16. Sheldon, W.H. (1954), Atlas of Man, Harper and Brothers, New York (in Eng).

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THE INFLUENCE OF PLYOMETRIC TRAINING ON THE IMPROVEMENT OF SPECIAL PHYSICAL PREPARATION OF HIGH-QUALIFIED VISUALLY IMPAIRED SPRINTERS DURING PRE-COMPETITION STAGE

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Purpose: describes the effectiveness of applying plyometric training on different flooring of highly qualified visually impaired sprinters at the pre-competition stage.

Material and methods: the indicators of special physical fitness of the Honored Master of Sports of Ukraine in para-athletics among athletes with visual impairments during the pre-competition stage of the annual macro-cycle were studied. The following methods were used: analysis and generalization of scientific and methodological literature, analysis of training loads and processing of parameters of training activity, testing of the level of development of high-speed and speed-power, pedagogical observation, methods of mathematical statistics.

Results: changing the flooring on which plyometric exercises were performed led to positive changes in the performance of the athlete's physical fitness.

Conclusions: the use of preparation at the pre-competition stage of a highly qualified visually impaired sprinter in the six-week plyometric program contributed to a significant increase in speed and speed-power indices of the athlete ($p < 0.05$-0.01).

Keywords: plyometric, special physical preparation, pre-competition stage, visually impaired.

Introduction

The rapid growth of sports results in Paralympic sports dictates the need to create new methods and approaches in the system of sports training. These circumstances call for the creation, improvement and modernization of methodological developments that help increase the effectiveness of the content and organization of the training process [2, 4]. This is especially important for visually impaired athletes, because the reduction of the functions of the visual analyzer affects the work of other sensory systems and the body as a whole [6, 10, 12].

It is generally accepted that the basis of sprinters training is the use of various exercises for speed, speed-power and power [5]. Many experts prefer running and jumping exercises, similar in their kinematic and dynamic structure with competitive exercise [1, 5]. Plyometric is considered to be one of the methods often used in sports to achieve the required sports form. Plyometric exercises are used in many sports, including jumping, and are aimed at forming the technique of their implementation [3, 7, 11]. S. Kramskoy, K. Herodek, S. Markovic, R. Stankovic believe that based on tendon reflexes to reproduce the "explosive" reaction, plyometric is a connecting factor between speed and power [8]. Plyometric method helps to increase power, helping the nervous system to "enable" and activate muscles, that is, it "forces" the muscles to develop the most effort in the shortest period of time [8, 9].

The scientific and scientific-methodical literature describes the application of the plyometric method of training in many Olympic sports. The use of plyometric exercises in the training of Paralympic athletes today has no scientific justification. The coaches of the Paralympic national team of Ukraine in the training process use a variety of such exercises, relying on practical experience in training athletes who do not have abnormalities in health. Therefore, the study and elucidation of the effectiveness of plyometric exercises for the development of speed and speed-power abilities of high-qualified visually impaired sprinters is relevant.

Purpose of the study: describes the effectiveness of applying plyometric training on different flooring of highly qualified visually impaired sprinters at the pre-competition stage.

The study was performed on the topic «Improvement of the training process of disabilities athletes in various sports» for 2016-2020 (state registration number 0116U008944).

Material and Methods of research

The research was conducted at the pre-competition stage of the annual macro-cycle (September - October 2019) during the preparation of the athlete for the World Para Athletics Championships. The research was participated by Honored Master of Sports of Ukraine in athletics among visually impaired athletes, Paralympic champion, world record holder.

The following methods were used in the work: analysis and generalization of scientific and methodological literature, analysis of training loads and processing of parameters of training activity, testing of the level of development of high-speed and speed-power, pedagogical observation, methods of mathematical statistics.

Results of the research

At the beginning of the pedagogical research before the application of the experimental training program, the following level of special physical fitness was observed in the athletes (tab. 1).

Table 1

Indicators of the level of development of speed and speed-power abilities at the beginning of the research

Indicator	Results	
	$\overline{X} \pm \sigma$	V%
Standing broad jump (m	2,51±0,06	2,22
Standing triple jump (m	7,23±0,04	0,50
30 м sprint (s)	3,97±0,03	0,67
60 м sprint (s)	7,41±0,04	0,49

The athlete performed each exercise three times during testing. All results corresponded to the model indicators for high-qualified visually impaired sprinters. The coefficients of variation were 0,49 – 2,22%, indicating the close homogeneity of the results, which confirms the skill of the athlete. We have developed a six-week program of plyometric in order to improve the special physical fitness of high-qualified visually impaired sprinters. The training program provided change flooring on which plyometric exercises were performed. The first three weeks the plyometric exercises were performed on the sand, the next three weeks – on the seamless polyurethane sports coating of the athletics stadium Estadio Olimpico Antonio Dominguez in Santa Cruz de Tenerife, (Spain). The athlete's training program consisted of three training sessions in the gym, three plyometric training, two technical training and two recovery training (cross, yoga, swimming). The duration of each practice ranged from 1 to 2.5 hours. Plyometric were performed on Monday, Wednesday and Saturday after an individual warm-up for a visually impaired athlete. The plyometric training program is depicted in table 2.

Table 2

The program of plyometric exercises

Day	Exercise	Quantity
Monday	Alternate leg bounds	5 × 40 repetitions
	Frog squat jump	5 × 20 repetitions
	Alternating lunge jump	5 × 20 repetitions
	Skater squat with jump	3 × 20 repetitions
	Sparrows squat jump	3 × 20 repetitions on each leg
Wednesday	Alternate leg bounds	5 × 40 repetitions
	Squat jumps	3 × 20 repetitions
	Mountain climber	3 × 40 repetitions
	Burpees	3 × 20 repetitions
	Sparrows squat jump	3 × 20 repetitions
	Tuck jumps	3 × 20 repetitions
Saturday	Alternate leg bounds	5 × 40 repetitions
	Single-leg bounds	3 × 20 repetitions
	Kneeling jump squat	5 × 20 repetitions
	Reverse lunge with knee-ups	3 × 20 repetitions
	Alternate leg bounds from place	3 × 20 repetitions

The duration of rest between sets of plyometric exercises was regulated and controlled by external signs of fatigue and heart rate of the athlete (according to the recommendations of the ophthalmologist, the heart rate of the athlete after exercise should not exceed 174 beats/min.).

After three weeks of using plyometric exercises on the sand, we tested the level of special physical fitness of the researched athlete (tab. 3).

Table 3

Indicators of the level of development of speed and speed-power abilities after 3 weeks of training

Indicator	Initial testing		Intermediate testing		Reliability of estimate		
	$\overline{X} \pm \sigma$	V%	$\overline{X} \pm \sigma$	V%	T	t гр	P
Standing broad jump (m)	2,51±0,06	2,22	2,54±0,06	2,17	5,00	4,30	<0,05
Standing triple jump (m)	7,23±0,04	0,50	7,29±0,04	0,49	6,00	4,30	<0,05
30 м sprint (s)	3,97±0,03	0,67	3,93±0,03	0,64	3,61	4,30	>0,05
60 м sprint (s)	7,41±0,04	0,49	7,33±0,04	0,49	6,93	4,30	<0,05

Reliably significant changes were observed in all tests, except for the 30 meter sprint ($p < 0,05$) (tab.3). In the run indicators for 30 meters were not observed statistically significant changes between initial and intermediate testing ($p > 0,05$). In our opinion, the slight increase in the results of the 30 m sprint race is explained by the relatively short time between the initial and intermediate testing, as well as the use of plyometric exercises on an unstable surface – sand. The next testing of the athlete was conducted at the end of a six-week plyometric program (tab. 4). The last 3 weeks the exercises were performed on the seamless polyurethane sports coating of the athletics stadium Estadio Olimpico Antonio Dominguez in Santa Cruz de Tenerife, (Spain).

An analysis of the results indicates significant changes in all studied indicators ($p<0,05$-$0,01$). The largest increase was observed in the results of standing broad jump – 6,5% and standing triple jump – 3,3%. The athlete's result in the 30 meter sprint improved from 3,97 ± 0,03 s to 3,86 ± 0,04 s. The athlete overcame distance 60

meter by 2,9% faster than in the beginning of the research. Changing the flooring on which plyometric exercises were performed led to positive changes in the level of development of high-speed and speed-power abilities of the muscles of the athlete's legs at the pre-competition stage.

Table 4

Indicators of the level of development of speed and speed-power abilities at the beginning and end of the research

Indicator	at the beginning research		at the end of the research		Reliability of estimate		
	$\overline{X}$	σ	$\overline{X}$	σ	T	t rp	P
Standing broad jump (m)	2,51	0,06	2,67	0,08	12,25	4,30	<0,01
Standing triple jump (m)	7,23	0,04	7,47	0,08	8,67	4,30	<0,05
30 м sprint (s)	3,97	0,03	3,86	0,04	12,85	4,30	<0,01
60 м sprint (s)	7,41	0,04	7,19	0,06	13,00	4,30	<0,01

These changes also affected the competitive result of the athlete, who won two gold and bronze medals in the 100 m, 200 m and 400 m, respectively, at the World Para Athletics Championships 2019 in Dubai (UAE). The athlete showed the result of season best in the 100 m and 400 m. The 200 meter race visually impaired sprinter improved her personal best for 0.27 seconds. In our opinion, the show of results was contributed by the use of plyometric, which had a positive effect on the condition of the musculoskeletal system of the athlete, which, in turn, made it possible to more quickly and powerful push off from the support.

Conclusions / Discussion

The scientific and scientific-methodical literature describes the application of the plyometric method of training in many Olympic sports, however, its use in the preparation of Paralympic athletes isn't in scientific materials.

The research confirmed the existing view, that the basis of visually impaired sprinters training is the use of various exercises for speed, speed-power and power.

The informations of S. Kramskova, K. Herodeka, S. Markovica and R. Stankovica on the effectiveness of plyometric method is expended and supplemented.

We found that the program of plyometric exercises on different flooring has a positive effect on the condition of the musculoskeletal system of the athlete, which, in turn, make it possible to more quickly and powerful push off from the support.

An analysis of results, after applying a six-week plyometric program at the pre-competition stage of a highly- qualified visually impaired athlete, showed that the results in standing broad jump, standing triple jump, 30 m and 60 m sprint significantly changed ($p < 0,05$).Thus, the use of preparation at the pre-competition stage of a highly qualified visually impaired sprinter in the six-week plyometric program contributed to a significant increase in speed and speed-power indices of the athlete.

Further development of scientific research. The materials of research will allow to analyze the preparation of highly-qualified visually impaired sprinters of annual macro-cycle.

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References

1. Artyushenko, F. O. and Sirenko, L. V. (2006), Osnovy sportyvnoi pidhotovky [Basics of sports training], navch. posibn., Cherkasy, Brama-Ukraina, 416 p. (in Ukr.)
2. Briskin, Yu. A., Evseev, S. P. and Perederiy, A. V. (2010), Adaptivnyiy sport [Adaptive sport], Moskow, Sovetskiy sport, pp. 271-288 (in Russ.)
3. Wendlerand, D. (2006),"Strength training: maximum effort cycles", Mir sily, No 3, pp. 28-30. (in Russ.)
4. Evseev, S. P. and Evseeva, O. E. (2015),"Theoretical problems of adaptive sports at the present stage", Kul'tura fizicheskaya i zdorov'ye, Vol. 4, No 55, pp. 78-83. (in Russ.)
5. Platonov, V. N. (2015), Sistema podgotovki sportsmenov v olimpiyskom sporte. Obschaya teoriya i ee prakticheskie prilozheniya [The system of training

athletes in Olympic sports. General theory and its practical applications], Kiev, Olimpiyskiy sport, 680 p. (in Russ.)

6. Shesterova, L. Ye. (2015),"Influence of visual impairment on individual indicators of the functional state of the sensory systems of middle school students", Slobozhans′kyy naukovo-sportyvnyy visnyk, No 4, pp. 96-99. (in Ukr.)

7. Hitzeman, S. A. and Beckerman, S. A. (1993), "What the literature says about sports vision", Optom Clin. Vol. 3, No 1, pp. 145-152. (in Eng.)

8. Kramskoy, S. I., Herodek, K., Markovic, S. and Stankovic, R. (2009), "Plyometric training for development explosive strength of legs for selected handball players", Fizicheskoye vospitaniye studentov, № 2, pp. 168-174. (in Eng.)

9. Shaji, J. and Isha, S. (2009), "Comparative analysis of plyometric training program and dynamic stretching on vertical jump and agility in male collegiate basketball player", Al Ameen J Med Sci, Vol. 2, № 1, pp. 36-46. (in Eng.)

10. Weber, W. (1992), Mechanics of the human walking apparatus, Berlin, Springer-Verlag, 242 p. (in Eng.)

11. Winter, D. (1990), Biomechanics and motor control of Human movement, New York, John Wiley & Sons, 277 p. (in Eng.)

12. Wylegala, A. (2016), "The effects of physical exercises on ocular physiology", J Glaucoma. Vol. 25, № 10, pp. 843-849. (in Eng.)

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FORMATION OF TECHNICAL AND TACTICAL ACTIONS OF TAEKWONDO ATHLETE 11-12 YEARS OLD

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Purpose: optimization of the process of teaching the technical and tactical actions of young taekwondo athlete of 11-12 years old.

Material and methods: in order to conduct the experiment, two groups were completed. The experimental and control groups consisted of 12 athletes each. At the beginning and at the end of the pedagogical experiment, the method of expert evaluations was used, the elements of effective and often used in competitive fights technical and tactical actions of young taekwondo players were counted. Research methods: theoretical analysis and generalization of literary sources, pedagogical observations, method of expert assessments, determination of indicators of competitive activity of young taekwondo athlete aged 11-12, methods of mathematical statistics.

Results: in the pedagogical experiment, for each athlete in the experimental group, the optimal trajectory of the shock movement was determined using the «ATAKA» computer program, in which the greatest effect of the force and speed of the impact is achieved. The introduction of an experimental training technique has allowed young taekwondo athletes to increase their competitive performance. The number of real and evaluated attacks in the study group increased by 1,9% ($t = 5,13$; $p < 0,001$) and

7% (t = 10,00; p <0,001). Attack efficiency improved by 8,6% (t = 4,35; p <0,001), the interval of attacks decreased by 9,3%, the number of net victories increased by 8,2% (t = 4,11; p <0,01), and the number of warnings decreased by 8,6% (t = 2,50; p <0,05).

Conclusions: the data obtained allowed us to conclude that the use of this technique using the «KORPUS» simulator and the «ATAKA» computer program in the taekwondo training system provides positive changes in technical and physical fitness in the experimental group compared to the control group.

Keywords: taekwondo, young taekwondo athletes, training, technical and tactical actions, training device.

Introduction

Steady growth in the number of competitions requires the athlete to significantly develop special physical qualities and competent tactical skills of the fight. The high importance of psychological training at each stage of training is due to the special importance of the attitude of a young taekwondo fighter to the results of performances at competitions of any level [5, 6].

Our proposed algorithm [3, 4] of comprehensive assessment of the level of training of young taekwondo fighters takes into account the mistakes made in demonstrating the elements of punching techniques and tactics of the fight, allows you to more objectively assess the readiness for competitive activities in the consistent implementation of the following stages:

- Assignment of athletes to one of the five qualification levels, taking into account age and seniority;

- determining the level of significance of different sections of sports training depending on the level of qualification of young taekwondo fighters;

- development of statistical and mathematical tools for comprehensive assessment of the level of sports training of young taekwondo fighters;

- attestation for qualification, counting the number of mistakes made in the implementation of control standards, and determining the integrated indicator of the level of sports fitness of a young taekwondo fighter.

The use of an integrated indicator of the level of sports preparedness of a young taekwondo fighter helps to increase the objectivity of the assessment.

Analysis of the competitive activity of a taekwondo fighter testifies that it takes place in constantly changing conditions, with a lack of time and the need to make decisions in the face of the enemy [4, 11, 12]. Young taekwondo fighters use basic techniques several times more often than everyone else. Analysis of such studies indicates the need at the appropriate stage of sports training to improve the basic technique of taekwondo and make appropriate adjustments to programs for the development and improvement of special physical training and taekwondo.

The level of technical and tactical actions of the athlete largely determines his success in the fight [1, 2]. At the same time, the achievement of maximum performance in competitive activities is directly related to the total amount of training loads, which have reached critical values [7, 8]. The latter forces coaches and athletes to look for more effective ways to train. At the initial stages of long-term training, the sports result is determined by the perfection of movements that form the basis of the technical equipment of taekwondo. Based on the results of scientific research [8, 9, 13], it can be argued that the success of young taekwondo athletes 11-12 years in competitions, mainly depends on the ability to technically perform relatively simple offensive and defensive actions, the ability to move quickly and timely. and take into account the distance to the opponent.

The purpose of the research: optimization of the process of teaching the technical and tactical actions of young taekwondo athlete of 11-12 years old.

Material and methods of research

The choice of research methods was determined by the purpose, objectives and existing requirements for pedagogical research.

The following methods are used in the work: theoretical analysis and generalization of literary sources, pedagogical observations, method of expert

assessments, determination of indicators of competitive activity of young taekwondo athletes aged 11-12, methods of mathematical statistics.

For the purpose of carrying out experiment two groups, experimental and control on 12 athletes in everyone were completed. At the beginning and at the end of the pedagogical experiment, the method of expert assessments was used, the sports training of young taekwondo fighters was assessed, and the elements of effective and often used in competitive duels technical and tactical actions were calculated.

To determine the level of technical readiness of the subjects and to determine the differences between the experimental and control groups before the experiment, a pedagogical assessment was given of kicks with rotation and without rotation in the jump. The evaluation for the execution of the blow was carried out by three judges of the I-st category on the basis of the current rules of taekwondo.

In the pedagogical experiment for each athlete in the experimental group, the optimal trajectory of the impact movement was determined using the computer program "ATTACK", within which the greatest effect of force and speed of impact is achieved.

Clarification of the conditions of the blows with the help of the technique with the use of the training device "BODY" and the computer program "ATTACK" as a means of correcting information, allowed to increase the speed, force of impact and form the correct stereotype of attacking techniques. The technique created by us corrects the information on the basis of use of the computer program "ATTACK", allows to make adjustments in structure of shock movement and to influence the final result that promotes training of blow in short term.

Special technical means promote effective development of motor abilities of the athlete, at the same time improve technical abilities, skills and physical qualities during sports training, create necessary conditions for exact control and management of the most important parameters of training loading. Thus, modeling of technical and tactical training in taekwondo with the use of training devices are relevant and require careful research and implementation in the training process of taekwondo [1, 2, 9, 10, 14].

When developing the training device "BODY" we tried:

- to develop a system of counterattack actions, which in the conditions of the knocking down factor, consists of consecutive algorithms of counterattack blows for the purpose of preparation of those who are engaged in a choice of this or that action depending on the developed tactical and technical situation;

- to teach athletes, on the basis of logical analysis of the situation, which develops in the shortest possible time to choose an adequate action or counteraction;

- to teach those involved in assessing the situation in one form or another to anticipate the development of further events, the results of the opponent's actions.

According to the experiment, separate technical and tactical tasks were simulated, offered by those who deal with the help of the training device "BODY", to improve the technique of attacking actions in the conditions of the confusing factor. For high-quality learning of practical material, we proposed a test based on the computer program "ATTACK". Thus, as a result of the pedagogical experiment, the subjects of the experimental group were offered a method of teaching the technique of attacking and counterattacking in taekwondo.

Connection of work with scientific programs, plans and topics. The study was conducted in accordance with the theme of research work KhDAFK 2016-2020 "Psycho-sensory regulation of motor activity of athletes of situational sports" (state registration number 0116U008943).

Results of the research

The proposed evaluation technology allowed us to achieve significant changes in almost all indicators of sports fitness of the experimental group of young taekwondo fighters in comparison with the control group. It was found that the taekwondo fighters of the experimental group are more effective in implementing the technical and tactical arsenal and their functional and psychological readiness in competitive duels than the athletes of the control group. The practical application of the technology developed by us to assess the sports fitness of young taekwondo fighters during the annual training cycle has increased the efficiency and effectiveness of their performances at competitions.

Thus, if at the beginning of the annual macrocycle there was no significant difference between the indicators of competitive activity between the studied groups (p> 0,05), then at the end of the experiment the best were obtained in the group in which the experimental method was used (Table 1).

In the experimental group, the number of real (t = 3,90; p <0,01) and estimated attacks (t = 9,45; p <0,001) increased compared to the control group, and the interval of attacks decreased (t = 2,54; p < 0,05) and increased the effectiveness of attacks (t = 4,72; p <0,001) and defense (t = 2,73; p <0,05), and ultimately increased the number of net victories (t = 4,52; p <0,001) (Table 1).

Table 1

Indicators of competitive activity of young taekwondo athletes 11-12 years of EG and CG after the experiment (n1 = n2 = 12)

Indicators	CG	*EG*	Reliability assessment	
	$x_1 \pm m_1$	$x_2 \pm m_2$	t	p
Number of real attacks	5,5±0,08	6,4+0,10	3,90	<0,01
Number of estimated attacks	2,5±0,09	3,7±0,09	9,45	<0,001
Attack interval (s)	48,8±0,94	45,5±0,9	2,54	<0,05
Attack efficiency (%)	45,3±1,10	53,8+1,3	4,72	<0,001
Protection efficiency (%)	45,8 ±0,90	49,9+1,2	2,73	<0,05
Number of net victories	3,0±0,12	3,8±0,13	4,52	<0,001
Number of warnings	1,2±0,03	1,2+0,06	0,00	>0,05

Along with this, the introduction of experimental training techniques allowed young taekwondo fighters to increase all indicators of competitive activity (Table 2).

The number of actual and estimated attacks increased by 1,9% (t = 5,13; p <0,001) and 7% (t = 10,00; p <0,001). The effectiveness of attacks improved by 8,6% (t = 4,35; p <0.001), and protection by 9,4% (t = 5.51; p <0,001), the interval of attacks decreased by 9,3% (t = 3, 00; p <0.05), the number of net victories increased by 8,2% (t = 4,11; p <0,01), and the number of warnings decreased by 8,6% (t = 2,50; p <0,05).

Table 2

Competitive activity indicators of young EG taekwondo players before and after the experiment (n1 = n2 = 12)

Indicators	*EG*		Reliability assessment	
	Before the experiment	After the experiment	t	p

	$x_1 \pm m_1$	$x_2 \pm m_2$		
Number of real attacks	5,6±0,12	6,4+0,10	5,13	<0,05
Number of estimated attacks	2,6±0,06	3,7±0,09	10,00	<0,05
Attack interval (s)	49,1±0,8	45,5±0,9	3,00	<0,05
Attack efficiency (%)	46,4±1,1	53,8+1,3	4,35	<0,05
Protection efficiency (%)	41,3±1,0	49,9+1,2	5,51	<0,05
Number of net victories	3,1±0,11	3,8±0,13	4,11	<0,05
Number of warnings	1,4±0,05	1,2+0,006	2,50	<0,05

In turn, the control group obtained positive results in all indicators, but their shifts are not significant (Table 3).

Table 3

The results of comparative testing of adaptation of young taekwondo fighters control (n = 12) and experimental (n = 12) groups at the end of training loads (x ± σ)

Kicks	CG	*EG*	P
	Heart rate, beats per minute		
Ap chagi	122,3±3.7	114,9±2,8	p < 0,05
Dolly Chagi	131,2±4,0	120,3±3,2	p < 0,05
Yup chagi	127,1±6,3	124,9±4,8	p > 0,05
Horo chahi	141,7±4,3	132,6±3,1	p < 0,05
Nerio chagi	138,9±4,9	129,4±2,9	p < 0,05
	VR, c		
Ap chagi	0,0,25±0,03	0,0,21±0,02	p < 0,05
Dolly Chagi	0,0,26±0,04	0,0,22±0,03	p < 0,05
Yup chagi	0,0,23±0,03	0,0,21±0,02	p < 0,05
Horo chahi	0,0,26±0,04	0,0,23±0,02	p < 0,05
Nerio chagi	0,0,25±0,04	0,0,22±0,03	p < 0,05
	AM, %		
Ap chagi	48,6±5,0	45,1±3,9	p < 0,05
Dolly Chagi	52,9±4,6	47,8±3,6	p < 0,05
Yup chagi	54,7±5,9	48,9±6,0	p < 0,05
Horo chahi	63,8±5,4	54,5±4,6	p < 0,05
Nerio chahi	79,1±5,6	73,8±3,1	p < 0,05
	IN, y.o.		
Ap chagi	286,8±39,4	237,4±29,6	p < 0,05
Dolly Chagi	423,2±52,6	276,3±42,4	p < 0,05
Yup chagi	428,7±36,8	329,4±32,2	p < 0,05
Horo chahi	694,3±32,7	576,8±33,9	p < 0,05
Nerio chahi	422,7±38,6	388,2±38,1	p < 0,05

At all stages of the experiment we determined the indicators: heart rate (HR), beats per minute; variation of heart rate (BP; amplitude of heart rate (AM),%; voltage index of regulatory systems (IN) according to RM Baevsky, conventional units

(USD) [3, 5, 6, 8].

In our opinion, the procedure for assessing the sports fitness of young taekwondo fighters should take into account the elements of effective and often used in competitive duels technical actions. As a result of the analysis of modern competitive activity of taekwondo fighters, we found that a significant number of blows in sparring athletes spend mainly four technical actions - it's "pit-chagi", "dvid-chagi", "dolio-chagi" and "nerio-chagi". They make up more than 86,3% of the total number of shots assessed by the judges in the 127 matches we surveyed. These strikes are used by taekwondo fighters mainly in all attacking and counterattacking actions, as they are most effective in competitive duels. This is due to the lack of technical, tactical and psychological training of young taekwondo fighters.

In addition to expert evaluation, we found a high degree of adaptation of young taekwondo fighters to perform special equipment, which was confirmed by a special experiment. One week before the experiment, a comparative test was performed, which assessed the physiological costs of performing motor actions in order to indirectly assess the special endurance. The control and experimental groups were asked to perform five main kicks 20 times (10 right and 10 left) after a 15-minute warm-up. The rest time before the next blow was 30 seconds. At the end of each series of strokes, the following indicators were measured: heart rate, VR, AM and IN. The results obtained are presented in table. 3.

Analysis of heart rate in the performance of percussion techniques in the control and experimental groups revealed that the young taekwondo athletes of the experimental group showed smaller values, and this indicates better functional and technical readiness.

Conclusions / Discussion

The obtained data allowed us to conclude that the use of the technique with the use of the simulator "BODY" and the computer program "ATTACK" in the system of training taekwondo players provide positive changes in technical, physical and functional training in the experimental group compared to the control group.

The advantage of the experimental technique in comparison with the traditional

one is the optimization of the process of learning motor actions in taekwondo, the development of physical and technical preparedness, which is reflected in the growth of the studied indicators, in contrast to the control group.

During the experiment, positive changes were obtained in the indicators of competitive activity of young taekwondo athletes of the control and experimental game. Thus, as in the control group the obtained results do not have significant changes, in the experimental group during the annual study significantly improved the number of real attacks ($t = 5,13$; $p < 0,001$), the number of estimated attacks ($t = 10,00$; $p < 0,001$), attack intervals ($t = 3,00$; $p < 0,05$), attack effectiveness ($t = 4,35$; $p < 0,01$), defense effectiveness ($t = 5,51$; $p < 0,001$), the number of net victories ($t = 4,11$; $p < 0,01$) and the number of warnings decreased ($t = 2,50$; $p < 0,05$).

Analysis of the VR revealed the existence of statistically significant differences in athletes of the control and experimental groups. This proves the effectiveness of our methodology, which allows you to teach technical actions faster. The indicators of AM and IN in the experimental group are also lower, which indicates that the young taekwondo fighters who trained in our program with the use of special training exercises, the reaction to special activities is not as pronounced as in the control group.

The obtained statistically significant differences in the readings of the control and experimental groups indicate that the developed method promotes faster training of young taekwondo practitioners in the technique of kicks. This indicates that the experimental technique has significantly improved the quality of the training process, reduced training time, optimized the process of learning motor actions in taekwondo, the development of physical and technical fitness, improved operational thinking of athletes and attacking techniques in taekwondo.

The introduction of an annual training process using algorithms for solving technical and tactical actions allowed young taekwondo fighters 11-12 years of the experimental group to increase the number of real and estimated attacks ($t = 5,13$; $10,00$; $p < 0,001$, respectively), attack efficiency and defense ($t = 3,00$; $p < 0,05$), and the number of warnings ($t = 2,50$; $p < 0,05$), which affected the number of net wins (t

= 4,11; p <0,01).

Prospects for further research lie in the theoretical and experimental substantiation and development of model characteristics of technical and tactical actions of qualified taekwondo athletes.

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References

1. Alekseev, A. F., Romanenko, V. V. (2004), "Improvement of methods of teaching techniques in taekwondo based on the analysis of competitive activities of qualified athletes", Slobozhans'kij naukovo-sportivnij visnik, № 9, pp. 92 - 94 (in Russ.).

2. Ananchenko, K. V., Boychenko, N. V., Pashkov, I. N. (2015), "Improvement of the combination technique of Kyokushinkai karate", Slobozhans'kij naukovo-sportivnij visnik, № 1 (45), pp. 29–33 (in Ukr.)

3. Arkania, R. A., Ananchenko, K. V. (2016), "Improving the sports training of young taekwondo fighters", Slobozhans'kij naukovo-sportivnij visnik, № 6 (56), pp. 7–11 (in Ukr.)

4. Basik, T. V., Kalashnikov, Yu. B., Shiyan, V. V. (2000), "Method of assessing the special endurance of taekwondo fighters", Theory and practice of phys. Culture: Coach: Journal in Journal, №1, p. 28. (in Russ.).

5. Golovanov, V. Yu. (1998), "Comparative analysis of the level of special training of athletes in taekwondo: The original method", Theory and practice of phys. culture: coach: magazine in magazine, № 1. pp. 34-37. (in Russ.).

6. Kashkarov, V. A., Vishnyakov, A. V., Khatkevich, K. V. (2008), "On the training and diagnosis of coordination abilities of young taekwondo fighters", Physical culture and health, №4, pp. 49- 50. (in Russ.).

7. Pashkov, I. N. (2015), "Methods for improving the coordination abilities of young taekwondo practitioners at the stage of preliminary basic training", Pedagogy,

psychology and medical and biological problems of physical education and sports, № 5, pp. 27–31. (in Russ.).

8. Romanenko, V. V. (2007), "Construction of biomechanical models of basic techniques performed by the feet for taekwondo novices", Slobozhans'kij naukovo-sportivnij visnik, 12, pp. 281-285. (in Russ.).

9. Romanenko, V. V., Rovny, A. S. (2009), "Formation of rational technique of taekwondo fighters on the basis of biomechanical analysis of techniques performed by qualified athletes", Slobozhans'kij naukovo-sportivnij visnik, № 1, pp. 102 - 108. (in Russ.).

10. Bompa, T. O. (1999), Total Training for Young Champions, Human Kinetics Publishers, 211 p. (in Eng.)

11. Capener, Steve (2000), Taekwondo: Spirit of Korea, Ministry of Culture and Tourism, Republic of Korea, 135 p. (in Eng.)

12. Foran, Bill (2001), "High-Performance Sports Conditioning USA", Human Kinetics (T), 376 p. (in Eng.)

13. Kim Sang H. (2000), Martial Arts After, Turtle Press, 345 p. (in Eng.)

14. Kraynik, Y., Mulyk, V., Perevoznik, V., & Koval, S. (2020), "The use of running and jumping exercises in special motor training of young forwards 13–14 years old", Slobozhanskyi herald of science and sport, №8(1), pp. 41-44. (in Eng.)

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THE RESULTS OF PHYSICAL REHABILITATION OF FOOTBALL PLAYERS OF 18-24 YEARS OLD AFTER INJURIES OF THE ANKLE JOINT

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Purpose: to improve the results of physical rehabilitation of football players of 18-24 years old with intra-articular injuries of the ankle joint at the outpatient stage by optimizing and improving the effectiveness of differentiated application of rehabilitation measures involved in the training process.

Material and methods: this work was based on the results of observation of 36 football players, conducted at the clinic of the Medical Center "Mir Majid Erslan" in Beirut (Lebanon). We evaluated the effectiveness of physical rehabilitation: according to the scales LEFS, VAS, according to the questionnaire Euro Qol - 5D, according to the methods of A.V. Kalashnikov and NEER.

Results: these studies indicate that with a positive dynamics of changes in the functional state of the injured in both clinical groups, more pronounced and significantly better are the results obtained in the injured main group, who underwent physical rehabilitation according to our proposed program.

Conclusions: the analysis of the results of the study showed that with the positive dynamics of changes in the functional state of the injured both clinical groups more pronounced and significantly better results were obtained in the injured main group,

who underwent physical rehabilitation according to the proposed program. In addition, the injured in the main group at the same time and volume of observation, these indicators were better than in the control group.

Keywords: injuries of the ankle joint, physical rehabilitation, oriental massage, oriental bath, outpatient stage.

Introduction

The complexity of the anatomical structure of the ankle joint, poor protection of soft tissues lead to the fact that at systematic high loads and frequent traumatic actions, the mechanical strength of its elements is insufficient. Ankle injuries account for up to 15% of all joint injuries in general, with the main contingent of patients with this pathology - young people of working age, including athletes [1].

Analysis of scientific research and analysis of statistics on the nature and location of traumatic injuries of the musculoskeletal system of athletes in sports, in particular in football, shows that in the zone of significant risk in the musculoskeletal system is the ankle joint, which accounts for about 30-40% of this pathology [2,3].

The state of modern traumatology can allow already at the outpatient stage to integrate programs of complex application of means of physical rehabilitation of athletes directly into the training process.

Material and Methods of research

The study was conducted at the clinic of the Medical Center "Mir Majid Erslan" in Beirut (Lebanon) on the basis of the office of physical rehabilitation during 2016-2018. This work was based on the results of observation of 36 athletes involved in football. All injured athletes were male, aged 18 to 24 years. Athletes who were injured were divided into two equal clinical groups - the main and control group (18 injured athletes each). The main and control groups were identical in age, manifestations of functional disorders and localization of the received injuries.

The study involved injured with closed injuries of the ankle joint types A1, A2, C1 and C2 according to the classification AO / ASIF [4].

The duration of the injury ranged from 4 to 6 months, with athletes from both clinical groups undergoing rehabilitation treatment for the first time. Injured athletes of the main clinical group underwent a course of rehabilitation treatment in parallel with the resumption of the training process.

Injured I (control) groups received a set of rehabilitation measures according to the traditional physical rehabilitation program adopted at the clinic of the Medical Center "Mir Majid Erslan".

The victims of the II (main) group were offered a set of rehabilitation measures according to the program developed by us.

The injured of both groups immediately before the rehabilitation treatment and at its completion underwent initial and repeated examination - 30 days after its onset, which allowed to assess the dynamics of changes in the body's systems.

We evaluated the effectiveness of physical rehabilitation according to the method of A.V. Kalashnikov, NEER method, LEFS scale (The Lower Extremity Functional Scale) [5]. To study the dynamics of changes in the quality of life of injured athletes and the level of vocational rehabilitation, we used medical and sociological techniques, namely: visual analog scale VAS (Visual Analog Scale) [6] and the questionnaire Euro Qol - 5D [7].

Anatomical and functional results of treatment of injured athletes with intra-articular injuries of the ankle joint were evaluated using quality assessment standards for treatment of injuries and diseases of the musculoskeletal system, set out in the Order of the Ministry of Health of Ukraine №41 from 30.03.94 "On regulation of orthopedic trauma in Ukraine" in accordance with the changes proposed by A.V. Kalashnikov (2006) [8].

The digital material obtained during the study was processed using the general-purpose data processing software package Statisticafor Windows version 6.0. Significance of differences between groups (comparison of average values for each group) was determined using Student's t test (t). The level of probability was taken as 95%.

Results of the research

Based on the analysis of modern and classical special literature, we proposed a clinical and physiological justification for the use of physical therapy, massage and physiotherapy in injured athletes with intra-articular injuries of the ankle joint, as well as created their own program of physical rehabilitation.

Injured athletes of group I (control) received a set of rehabilitation measures according to the generally accepted program of physical rehabilitation, adopted in the rehabilitation center of the clinic "Mir Majid Erslan".

Injured athletes of group II (main) received a set of rehabilitation measures in accordance with our proposed program of integrated use of physical rehabilitation.

Each injured athlete from both groups underwent initial and re-examination - before rehabilitation treatment, and at the end, 30 days after its start.

The program of physical rehabilitation of the injured of the control group consisted of 12 procedures of therapeutic massage of the injured limb, 12 procedures of magnetic therapy, 12 procedures of laser therapy and 24 classes of therapeutic exercises.

Magnetic therapy was prescribed to all patients - 1 session with magnetic field induction up to 30 mT. Laser therapy in all injured athletes was used taking into account the type of monochromatic radiation on the ankle joint and reflex zones, in a constant mode with a power of up to 25 mW for 15 - 30 seconds each, the total procedure time was 3 minutes.

Treatment of joint contractures was performed using the methods of classical therapeutic massage and conventional therapeutic exercises with increased range of motion at a slow pace. Mechanotherapy was not used in the physical rehabilitation program.

During the rehabilitation, the injured athletes of the main group received 12 training sessions with integrated therapeutic exercises, 12 bath procedures and 12 oriental massage procedures (Table 2).

Involvement of therapeutic gymnastics exercises in the training process was their integration into the structural parts of the training session, i.e. injured athletes began and ended the training together with the training of team players on the sports

field. Exercise exercises were performed directly on the training ground both separately and in combination with special football exercises with lightweight balls (with increasing difficulty, respectively). Special exercises were performed after exercise exercises, first for a healthy, then for an injured leg in the initial position sitting, standing, walking gradually.

Patients of the main group instead of a complex of physiotherapeutic procedures and massage were assigned a complex consisting of the combined use of the bath procedure of the conventional Arab bath and the procedure of oriental massage of the lower extremities. In the physical rehabilitation program, we used a modified procedure of the Arab-style Arab bath, common in the state of Lebanon, with "dry" heating of the steam room in the range from 45C ° to 60C ° and humidity up to 40%, without the inclusion of steam generators. This significantly reduced the load on the cardiovascular and respiratory systems of injured athletes and allowed more frequent and rhythmic use of this bath procedure in the course of physical rehabilitation. Before each procedure of steaming in the eastern bath, the patient's pulse, blood pressure were measured in the presence of a doctor, and the anamnesis of the condition was specified.

Previous hyperthermic effect on soft tissues and musculoskeletal system of injured extremities activated internal arterial hyperemia, increased elastic qualities of fibrous tissue, slightly reduced the threshold of pain sensitivity when performing amplitude movements, which allowed to effectively use the techniques of oriental massage of ankle joint. This has reduced the manifestations of both passive (structural) and active (functional) contractures of the injured joint.

Determination of functional indicators of the cardiovascular system before and after the course of physical rehabilitation showed that systolic, diastolic blood pressure and heart rate during the initial and repeated examinations were within normal limits, slightly increased in both groups. arithmetic mean values according to the results of measurements before and after the experiment using Student's t-test. The calculated value of the Student's t-test (t = 2,4) significantly exceeds the critical value (t_{cr} = 0,19; 0,06; 0,2), and the changes are not significant (p> 0,05), i.e.

significant changes in the state of functional indicators of the cardiovascular system of injured athletes of the main group during the study (30 days for each) did not occur.

From the analysis of the assessment of the results of physical rehabilitation according to the method of A.V. Kalashnikov shows that after the course of physical rehabilitation under the traditional program, the number of unsatisfactory results halved, the number of satisfactory results decreased by 22,2% and the number of good results doubled.

In the II (main) group, the data obtained indicate a significant increase in the share of good results, namely 2.1 times (up to 83,3%), which halved the number of satisfactory results (up to 16,7%), in the complete absence unsatisfactory results. This indicates the effectiveness of our proposed program of integrated use of physical rehabilitation.

Analysis of the results of physical rehabilitation according to the LEFS scale showed that after the course of physical rehabilitation according to the traditional program in the I (control) group the number of unsatisfactory results decreased by 11,1%, the number of satisfactory results did not change, and the number of good results increased slightly by 11,1 %.

The results of the evaluation of the data of the II (main) group convincingly show a significant increase in the number of good results, namely 6,5 times, and a significant decrease in the number of satisfactory results - almost 2,3 times. Of particular note is the decrease in the number of unsatisfactory results (almost 7 times), which shows the effectiveness of our proposed program of physical rehabilitation

The results of using the traditional physical rehabilitation program in the assessment of NEER in the I (control) group slightly improved, namely - the number of unsatisfactory results decreased by 5,6%, the share of satisfactory results decreased by 22,2%, due to a twofold increase in the share of good results - up to 55,6%

After a course of integrated use of physical rehabilitation for our proposed program, the results in the II (main) group significantly improved, namely - the

number of good results increased by 50% due to a significant decrease in the number of satisfactory results - by 27,8% and no unsatisfactory results after rehabilitation treatment

According to the EuroQol - 5D questionnaire for the traditional program in the I (control) group, the number of good results did not increase significantly - by 5,6%, obviously due to the same decrease in the number of unsatisfactory results, as the number of satisfactory results remained unchanged - 33,3 %

The use of physical rehabilitation under our proposed program allowed to significantly improve the results for the control group in the main, namely - the number of good results doubled from baseline to 88,9%, satisfactory - decreased 3,5 times and amounted to 11,1% , and unsatisfactory results were not found at all.

The indicator of VASH in I (control) group for 1 week after the beginning of rehabilitation improved and made 6,2 ± 0,41, on the 2nd and 3rd week its further improvement was noted (5,3 ± 0,37 and 4,4 ± 0,28, respectively), and the maximum improvement occurred at 4 weeks (2,9 ± 0,22), i.e. at the end of treatment ($p < 0,05$).

In injured athletes of the II (main) group, the values of VASH improved from 1 week of rehabilitation (5,7 ± 0,38). There was a clear reduction in pain at 2 and 3 weeks, which corresponds to 4,3 ± 0,23 and 2,8 ± 0,24 points, respectively, and reached its best value of 1,3 ± 0,18 in 4 weeks from the beginning of rehabilitation. Statistical confirmation of the obtained data was performed by comparing the arithmetic mean values of the measurements before and after the experiment using Student's t-test. The calculated value of the Student's t-test ($t = 25,67$) significantly exceeds the critical value ($t_{cr} = 2,04$), ie changes in the condition of injured athletes according to VAS are significant ($p < 0,001$).

The pedagogical experiment presented in this study involved 36 injured male football players who received intra-articular injuries of the ankle joint. Thus, our studies confirm the data of J.M. Hootman et al. (2007), H.R. Champion et al. (2009) [9,10] on the frequency and statistical dependence of such injuries on playing sports in general and football in particular.

The localization of injuries of sports injury in the studied contingent, namely the ankle joint, confirms the data of Navarro Suay R. et al. (2012) [11] that the vast majority of cases of lower limb injuries in game sports are due to intra-articular injuries of the ankle joint.

The data of S.N. Popov (2013), V.V. Abramov et al. (2014) [12,13] on the effectiveness and necessity of integrating the physical rehabilitation program into the training process of athletes.

During the course of physical rehabilitation in the control group by the traditional method was a combination of several common methods, which confirms the data of S.A. Neborsky (2005), O.V. Nikitin (2010) [14,15] on the feasibility of a comprehensive approach to physical rehabilitation for athletes.

Our research results confirm the data of N.M. Valeeva (2004) [16] on the significant positive impact of rehabilitation treatment on improving the quality of life of injured athletes, as well as on the resumption of work, household and professional activities.

Developed and implemented massage procedure, which includes a combination of massage techniques of classical and oriental massage and the results of using the bath procedure as a non-traditional method of restorative treatment, had an objectively confirmed effect of mechanical action on muscles, tendons, capsular ligaments, which complements the data of A.A. Biryukova (2014), V.I. Vasychkina (2016) [17,18].

Conclusions / Discussion

It is well known that one of the most pressing problems of modern physical rehabilitation of injured athletes is the rapid and full return of their athletic performance.

It is also known from many scientific sources that injuries of the ankle joint (its ligament-capsule apparatus) are the second most common of all joint injuries, and the victims need long-term treatment.

In this case, it is advisable to argue only on the choice of treatment tactics depending on the nature of the damage to both the cartilaginous structures of the joint

and the soft tissues surrounding it. True optimization of the process of return of active athletes to active professional activity can find a positive solution only if new treatment technologies are added to the existing traditional methods and approaches to accelerate the recovery process. The author of the article developed and implemented a physical rehabilitation program, which was attached directly to the training process to solve the problem of speedy restoration of the proper functional state of qualified athletes and their rapid return to active professional activity.

Data from the results of the study of the effectiveness of physical rehabilitation on the LEFS scale, the methods of A.V. Kalashnikov and NEER when using physical rehabilitation according to the generally accepted program found 66,7% good, 22,2% satisfactory and 11,1% unsatisfactory functional results and 55,6% good, 27,8% satisfactory and 16.6% unsatisfactory functional results. Indicators of quality of life of injured athletes of the control group with intra-articular injuries of the ankle joint in the process of using the generally accepted physical rehabilitation program on the VAS scale and the Euro Qol - 5D questionnaire in 22,2% of cases are completely satisfactory, in 55,6% - only partially and in 22, 2% of cases do not satisfy the injured athletes during the entire rehabilitation period.

The use of the program of physical rehabilitation according to the proposed program with injured athletes of the main group according to the results of the LEFS scale, the methods of A.V. Kalashnikov and NEER allowed to obtain 83,3% of good and 16,7% of satisfactory functional results, and 72,2% of good and 27,8% of satisfactory functional results. Analysis of quality of life of injured athletes of the main group with intra-articular injuries of the ankle joint in the process of integrated use of physical rehabilitation according to the proposed program on the VAS scale and the questionnaire Euro Qol - 5D showed 72,2% good, 22,2% satisfactory and 5,6 % unsatisfactory results throughout the rehabilitation course.

The analysis of the results of the study shows that with the positive dynamics of changes in the functional state of the injured of both clinical groups more pronounced and significantly better results were obtained in the injured II (main) group, who underwent physical rehabilitation according to our proposed program

using integrated into the training process of therapeutic gymnastics, procedures of the modified ethnic Arab bath and consistent use of procedures with elements of oriental massage.

Prospects for further research. Implementation of the proposed program of physical rehabilitation of athletes with intra-articular injuries of the ankle joint with the use of integrated in the training process therapeutic gymnastics, procedures of the modified Arab bath and sequential use.

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References

1. Abramov, V. V., Smirnova O. L., (2014), Fi`zichna reabi`li`taczi`ya, sportivna mediczina [Physical rehabilitation, sports medicine]: pi`druchnik, Dni`propetrovs`k, 455 p. (in Ukr.)
2. Biryukov, A. A. (2014), Sportivny`j massazh [Sports massage]: monografiya, Moskva, 576 p. (in Russ.)
3. Valeev, N. M. (2009), Vosstanovlenie rabotosposobnosti sportsmenov posle travm oporno-dvigatel`nogo apparata [Restoration of working capacity of athletes after injuries of the musculoskeletal system]: monografiya, Moskva, 304 p. (in Russ.)
4. Vasichkin, V. I. (2016), Bol`shoj spravochnik po massazhu [A great guide to massage]: spravochnoe izdanie, Moskva, 416 p. (in Russ.)
5. Gajko, G. V., Kalashni`kov, A. V., Vdovi`chenko, K. V. (2010), "The choice of treatment for patients with diaphyseal fractures of the tibia", Ukrayins`kij medichnij al`manakh, No. 13 (1), pp. 40-43. (in Ukr.)
6. Gershburg, M. I. (1997), Posleoperaczionnaya reabilitacziya sportsmenov s razry`vami akhillova sukhozhiliya [Postoperative rehabilitation of athletes with Achilles tendon ruptures]: metodicheskie rekomendaczii. Moskva, 36 p. (in Russ.)

7. Epifanov, A. V, Achkasov, E. E, Epifanov, V. A. (2015), Mediczinskaya reabilitacziya [Medical rehabilitation]: uchebnik, Moskva, 668 p. (in Russ.)
8. Neborskij, S. A. (2005), Tradiczionny`e metody` lecheniya v mediczinskoj reabilitaczii postradavshikh s posledstviyami minno-vzry`vny`kh ranenij [Traditional methods of treatment in medical rehabilitation of victims with the consequences of mine injuries] avtoref. dis. na soiskanie uch. stepeni kand. ped. nauk: 14.00.03, Tula; 2005. 168 p. (in Russ.)
9. Nikitina, O. V. (2010), "Physical rehabilitation in the early postoperative period after blocked intramedullary osteosynthesis of the hip", Problemi fi`zichnogo vikhovannya i` sportu, No. 6, pp. 79-81 (in Russ.)
10. Ochkurenko, A. A, Shirmazanyan, A. G, Maczakyan, A. M. (2017), "Modified arthroscopic stabilization of the ankle joint in chronic external instability", Vestnik vosstanovitel`noj mediczinу`, No. 4, pp. 53-57 (in Russ.)
11. Popov, S. N. (2013), Fizicheskaya reabilitacziya [Physical rehabilitation]: uchebnik, Moskva: T.1, 283 p. (in Russ.)
12. Sokrut, V. N., Yabluchanskij, N. I. (2015), Mediczinskaya reabilitacziya [Medical rehabilitation], Doneczk, 619 p. (in Russ.)
13. Yaremenko, D. A, Baburkina, E. P, Kishkar, A. V. (2000), " Arthrodesis in the aftermath of complicated ankle injuries", Ortopediya, travmatologiya i protezirovanie, No. 3, pp. 77-81 (in Russ.)
14. Binkley, J. M , Stratford, P. W , Lott, S. A. (1999), "The Lower Extremity Functional Scale (LEFS): scale development, measurement properties, and clinica lapplication", North American Orthopaedic Rehabilitation Research Network, vol. 79, № 4, pp. 371-383 (in Eng.)
15. Champion, H. R., Holcomb, J. B., Young, L. A. (2009), "Injuries from explosions: Physics, Biophysics, Pathology, and Required", Research focus: Trauma, vol. 66, №5, pp. 1468-1477 (in Eng.)
16. Cherkes-Zade, D., Monesi, M., Causero, A., Marcolini, M. (2003), "Surgical treatment of fractures of the distal femur using the LISS system", Vestnik travmatologii i ortopedii im. NN Priorova, No. 3, pp. 36-42 (in Russ.)

17. Hootman, J. M., Dick, R., Agel, J. (2007), "Epidemiology of collegiate injuries for 15 sports", Summary and recommendations for injury prevention initiatives, vol. 42, pp. 311-309 (in Eng.)
18. Navarro Suay, R., Abadía de Barbará, A. H., Gutierrez Ortega, C., (2012), "Gunshot and improvised explosive casualties": a report from the Spanish Role 2 medical facility in Herat, Mil Med, vol. 177, №3, pp. 326-332 (in Eng.)

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FEATURES OF THE MARKETING ACTIVITIES OF THE RUGBY CLUB "OLYMPUS" KHARKIV

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Purpose: to determine the features of the marketing activities of the "Olympus" rugby club for its further improvement.

Material and methods: using PEST-analysis, the influence of the external environment on the activities of the "Olympus" rugby club was characterized. Using SWOT-analysis, the opportunities and threats of the external environment and the strengths and weaknesses of the internal environment of the "Olympus" rugby club were identified. The survey was conducted among 10 organizational and managerial staff of the rugby club "Olympus" Kharkiv in order to determine the opinion of respondents regarding various aspects of its activities, as well as among 25 club rugby athletes in order to identify needs and priorities, motivate team players.

Results: substantiate the need for a marketing strategy, the development process of which in our study included 3 stages: analysis of the external and internal environment of the club; formation of goals, main directions and marketing complex; implementation and evaluation of marketing strategies. The organizational structure of the "Olympus" rugby club, its logo, and an analysis of the club's marketing communications are analyzed.

Conclusions: as a result of the study, we developed a marketing strategy for the "Olympus" rugby club and a plan for its practical implementation. The results of the

expert evaluation indicate that the marketing strategy we have proposed has the high expected effectiveness, scientifically justified, and real for implementation.

Keywords: rugby club, marketing, strategy, plan, marketing environment, marketing activities.

Introduction

In the basic regulatory documents of the sphere of physical culture and sports indicates that attracting the population to regular physical education and sports is a priority of state policy. As you know, rugby is an effective means of physical education and sports training, in particular for children and youth. Today, rugby is a dynamic and spectacular sports game that is cultivated on all continents [1].

In recent years, Kharkov has received the status of the real capital of rugby Ukraine. Kharkov club "Olympus" is the most titled Ukrainian rugby club, which has collected a huge collection of sports awards. Athletes of the Kharkiv Olimp Rugby Club make up the personnel base of the Ukrainian national rugby team [8].

An analysis of recent studies and publications indicates that the work of A.A. is devoted to scientific research on improving the training process of rugby players. A.A. Martirosyan [4], O. Sabirova [9], V.O. Muchy [6], O.M. Kvasnytsi [3], V.V. Pasko [7] and other scientists. The main attention of the authors is focused on the consideration of improving the technical, tactical and psychological training of rugby players, on solving the problem of socialization of the personality of a rugby athlete, on finding the most effective ways to organize the training process.

However, at present, scientists have considered only certain aspects of the problem of managing organizational, managerial and marketing activities of organizations whose activities are aimed at the development of rugby in Ukraine: V.V. Pasko, O.B. Podolyanina, A.A. Martirosyan, I.Yu. Filenko [8]. It was revealed that the problems of the activities of rugby clubs still remain outside the field of view of researchers. The relevance of this work is determined by the need to study the organizational, managerial and marketing activities of rugby clubs in today's

conditions and the introduction of the scientific foundations of management in the practice of their work.

Purpose of the study is to determine the features of the marketing activities of the "Olympus" rugby club for its further improvement.

Material and Methods of the research

In the course of our study, a set of mutually complementary methods of scientific research was used, namely: analysis of literary sources; analysis of documents; system analysis; survey (questionnaire) PEST-analysis; SWOT-analysis; expert review; methods of mathematical statistics. In the course of the study, a survey was conducted among 10 organizational and managerial employees of the Olympus rugby club Kharkiv in order to determine the respondents' opinions on various aspects of its activity, as well as among 25 club rugby athletes in order to identify the needs and priorities, motivation of team players.

Results of the research

In a market economy in the field of sports, the importance of marketing is increasing [2]. In the course of our study, it was determined that the leadership of the "Olympus" rugby club does not pay enough attention to marketing issues. One of the reasons for this situation is that professional clubs traditionally consider the fan as a convinced and unconditional fan, whose emotional dependence on the game is manifested in lifelong loyalty to their favorite team, another reason for the situation is the reluctance to treat the fan as a consumer, and the club’s management even don't think about developing and implementing a marketing strategy [11].

Obviously, improving the marketing activities of the club is impossible without a systematic approach, taking into account all the system-forming factors that affect the effectiveness of goals and objectives [2]. This, in turn, justifies the need to develop a marketing strategy. By “marketing strategy” we understand the totality of organizational and managerial goals, tasks and actions aimed at increasing the club’s income, strengthening the image and growth of the club’s sporting achievements.

The process of developing a marketing strategy in our study involved the sequential implementation of three stages, namely: research, development of a

marketing strategy, implementation and evaluation of a marketing strategy. Each next step is a logical continuation of the previous one. At the first stage “market research”, an analysis of the marketing (market) environment of the Olympus rugby club was carried out, including an analysis of the external and internal environment (identifying opportunities, threats, strengths and weaknesses of the club). At the second stage, the development of a marketing strategy took place, in particular, the formation of goals, main directions and a marketing complex. The third stage involved the implementation and evaluation of the implementation of the marketing strategy.

During the first stage of “market research”, it was found that the organizational structure of the "Olympus" rugby club is similar to professional sports clubs in all team sports. The club is headed by the president. The board of the club, headed by the president, decides all the issues of the functioning and development of the club. The current activities of the club are led by the president. The training process is led by the head coach. Assistant trainers help him. The club also has a doctor as a staff member. The strength of the team has 27 players, of which: 11 defenders, 3 midfielders and 13 forwards. The club has a children's school.

In the course of our study, an analysis of the marketing communications of the "Olympus" rugby club Kharkiv was carried out. An analysis of the official website and pages of the "Olympus" rugby club Kharkiv on social networks indicates a lack of activity regarding the club’s positioning on the Internet. The YouTube channel of the rugby club was created in 2015 and so far it has only 130 subscribers. In addition, the account of the rugby club on Instagram, in one of the most popular social networks among young people today, has not been created. The low attendance of the official site was determined. The low attendance of the official site was determined: 196 views and 40 visitors per day, 5,880 views and 1,472 visitors per month. Comparing the statistics of website traffic of such famous clubs as the football club Metalist 1925 and RSC Legion XIII, which have 3922 visitors per day, we can talk about the need to improve the site of the rugby club "Olympus".

The essence of the influence of the external environment on the club's activities was determined using PEST analysis (Table 1).

Table 1

Characteristics of the influence of the external environment on the activities of the "Olympus" rugby club, according to a staff survey (n=10)

№ i/o	Factors	Sum, $\sum$ points	$\bar{x}$ +m	%	Place
1.	Demographic environment (population endowment, population composition, level of urbanization, etc.)	21	2,1 ± 0,9	42%	5
2.	Economic environment (income level, utility tariffs, investment climate, etc.)	41	4,1 ±0,7	82%	1
3.	Political environment (tax legislation, monetary policy, etc.)	31	3,1 ± 0,7	62%	2
4.	Sociocultural environment (cultural structure, social stability, fashion, etc.)	27	2,7 ± 0,6	54%	4
5.	Scientific and technical environment (latest technologies, etc.)	30	3,0 ± 0,6	60%	3
6.	International environment (international events, global trends, etc.)	11	1,1 ± 0,3	22%	6
$\sum_{i-1}^{n} xi\max - 50$ $\sum_{i-1}^{n} xi\min - 10$					

In the course of our study, using the SWOT analysis, an assessment of the opportunities and threats of the external environment was obtained by factors: economic; political, technological and social.

It was revealed that the greatest environmental threats are the low level of interest of the rugby population ($\bar{x}$ =1,1), the shortage of qualified personnel ($\bar{x}$ =1,3) military operations in the east of the country ($\bar{x}$ =1,4) and others.

The main features of the "Olympus" rugby club include: the development of rugby in the city, country, world ($\bar{x}$ =4,9), the economic development of the region ($\bar{x}$ =4,8), the system of tax benefits and incentives ($\bar{x}$ =4,8), and others.

It was revealed that the strengths of the "Olympus" rugby club Kharkiv include: its own material and sports base ($\bar{x}$ =4,9), highly qualified coaches and players ($\bar{x}$ =4,9), the constant champion of Ukraine in rugby ($\bar{x}$ =4,9) and others. Weaknesses include: lack of a medical rehabilitation center ($\bar{x}$ =1,8) lack of a "sports manager" position ($\bar{x}$ =2,5) inadequate use of marketing tools ($\bar{x}$ =1,3) and others.

Based on the results of a study of the marketing environment of the "Olympus" rugby club, a matrix of SWOT analysis was constructed (Table 2).

Table 2

Matrix of the SWOT analysis of the "Olympus" rugby club

Internal environment	
S Strengths	W Weaknesses
S1 – own material and sports base; S2 – modern repair of premises; S3 – highly qualified coaches and players; S4 – high corporate culture; S5 – the ability to leave the team to compete abroad S6 – use of innovative training techniques; S7 – the constant champion of Ukraine in rugby; S8 – the presence of a children's school; S9 – use of Internet resources; S10 – positive reputation of the club	W1 – lack of a gym with modern equipment; W2 – lack of a medical rehabilitation center; W3 – lack of the position of "sports manager"; W4 – unreasonable long-term management planning; W5 – lack of funds for the recovery of players; W6 – lack of computer information technology; W7 – presence of strong competitors; W8 – lack of psychological support for athletes; W9 – lack of effective propaganda, advertising; W10 – underutilization of marketing tools
External environment	
O Opportunities	T Threats
O1 – stability of the national currency; O2 – availability and availability of credit funds; O3 – economic development of the region; O4 – political stability; O5 – system of tax benefits; O6 – the emergence of new equipment, inventory and the like; O7 – construction of new modern sports facilities; O8 – development of Internet technologies; O9 - population income growth; O10 – public commitment to sporting events; O11 – Rugby development in the city, country, world	T1 – inflation growth; T2 – economic crisis; T3 – increase in taxes, tariffs for utilities; T4 – military operations in the east of the country; T5 – insufficient development of the legal framework; T6 – the emergence of new competitors; T7 – outdated material and technical base; T8 – low attendance of matches; T9 – low level of interest in the rugby population; T10 – deficit of qualified personnel (trainers); T11 – low social security

Thus, the analysis of the marketing environment of the "Olympus" rugby club Kharkiv showed that it forms a competitive environment, has the potential for further development and a number of advantages, however, in the context of constant competition, issues of improving its marketing activities are becoming increasingly important.

The structure of our marketing strategy of the rugby club "Olympus" includes 7 sections: 1) the mission of the club; 2) the goals of the club; 3) target markets; 4) positioning of the club; 5) strategic goal and ways to achieve it; 6) marketing complex; 7) expected results. Based on the marketing strategy, we have developed a plan for its practical implementation. The developed plan contains measures of resource support for the implementation of the marketing strategy; events to orient the club's work towards the consumer; advertising and public relations events.

The structure of the plan includes 3 sections. The first section includes resource support measures for the implementation of the marketing strategy, the solution of which should be addressed by the club president, personnel service, and all organizational and managerial staff of the club. The section reflects activities aimed at expanding the club's personnel, conducting outreach with the club's staff regarding the fundamentals of marketing, and improving the club's material and sports work. The second section of the plan forms a block of measures to orient the work of the club towards the consumer. These measures include systematic marketing research, as well as the development of a marketing plan. The third section of the plan includes advertising and public relations activities aimed at improving the marketing activities of the rugby club in Internet resources, conducting campaign work in educational institutions to attract children to classes in a children's rugby school, and concluding cooperation agreements.

To identify the expected effectiveness of the marketing strategy we proposed, we conducted an expert assessment among the organizational and managerial staff of the club who took part in our study, and among academic experts in the field of sports marketing in the amount of 10 people (Table 3).

Table 3

The results of the expert evaluation of the expected effectiveness of the marketing strategy of the "Olympus" rugby club

Objects of examination	Experts, *m=10*										$\sum_{i=1}^{n} x_i$	Place
	1	2	3	4	5	6	7	8	9	10		
Strengthening the image of the club	5	5	5	5	5	5	5	4	4	5	48	1

Improving the club management mechanism	3	2	2	3	2	2	2	1	1	3	21	4
Development of initiative and creativity in organizational and managerial activities	2	1	1	1	1	1	1	1	2	1	12	5
Improving the competitiveness of club	5	5	4	4	4	4	4	4	4	4	42	2
Activation of promotional activities	2	3	3	2	3	3	3	3	2	3	27	3

Remark: $\sum_{i=1}^{n} x_{i\max} = 50$; $\sum_{i=1}^{n} x_{i\min} = 10$ $\sum_{i=1}^{n} \left(\left(\sum_{j=1}^{m} x_i \right) - \bar{x} \right)^2 = 850$

According to the results, the experts praised the possibility of strengthening the image of the club (48 points). The level of agreement of experts is high and confirms the reliability of the examination. The concordance coefficient was $W = 0{,}8$.

Conclusions / Discussion

The results of the study confirm the prevailing opinion that the problem of improving the organizational, managerial and marketing activities of subjects of the sphere of physical culture and sports does not lose its relevance [5; 10; 12]. The authors of the work reasonably considered the marketing activities of sports organizations, the nature, methods and technologies of marketing research, the process of forming a marketing strategy, and the like. In our study, for the first time, a comprehensive description of the organizational, managerial and marketing activities of a rugby club was carried out based on an analysis of its market (marketing) environment.

Research on improving the marketing activities of professional sports clubs was further developed. In the course of our study, using the PEST analysis, we determined the degree of influence of the external environment on the activities of the "Olympus" rugby club Kharkiv under study. The main opportunities and external threats were identified, the strengths and weaknesses of the activities of the "Olympus" rugby club were identified, on the basis of which the matrix of the SWOT analysis was built.

Based on the results of our own research, we developed a marketing strategy for the "Olympus" rugby club and a plan for its practical implementation. The results

of the expert assessment indicate the high expected effectiveness of the marketing strategy.

We associate the **prospects for further research in this direction** with the study of the brand-marketing communications of the "Olympus" rugby club in modern conditions of operation and the development of the club's brand strategy.

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References

1. Datsko, T. (2014), Dovidnyk z rehbi (zapochatkuvannia hry v sviti, v Rosiiskii ta Avstro-Uhorskii imperiiakh, v SRSR ta Ukraini) [The rugby guide (starting the game in the world, in the Russian and Austro-Hungarian empires, in the USSR and Ukraine)], Lviv : BONA, 312 p. (in Ukr.).

2. Ivanechko, N. R. (2013), "The process of forming a marketing strategy". Visnyk Dnipropetrovskoho universytetu. No. 7 (146). pp. 123-130. (in Ukr.).

3. Kvasnytsia, O. M. (2016), "Effectiveness of Rugby-7 Qualified Physical Training Programs", Naukovyi chasopys Natsionalnoho pedahohichnoho universytetu imeni M. P. Drahomanova. Seriia 15 : Naukovo-pedahohichni problemy fizychnoi kultury (fizychna kultura i sport). Vyp. 9. pp.. 51-55. (in Ukr.).

4. Martirosyan, A. A. (2006), Skorostno-silovaya podgotovka kvalifitsirovannyih regbistov v podgotovitelnom periode [Speed-power training of qualified rugby players in the preparatory period]: avtoref. dis. na soiskanie uch. stepeni kand. nauk po fiz.vosp. i sportu : 24.00.01. Harkov, 24 p. (in Russ).

5. Michuda, Yu. P. (2007), Sfera fizychnoi kultury i sportu v umovakh rynku: zakonomirnosti funktsionuvannia ta rozvytku [Sphere of physical culture and sports in market conditions: regularities of functioning and development], Kyiv, 216 p. (in Ukr.).

6. Mukha, V. O. (2013), "Improvement of psychological training of rugby players during contact actions", Visnyk Chernihivskoho natsionalnoho pedahohichnoho

universytetu. Pedahohichni nauky. Fizychne vykhovannia. Vol. 2, No. 107. pp. 267–270. (in Ukr.).

7. Pasko, V. V. (2016), Innovatsiini tekhnolohii udoskonalennia fizychnoi ta tekhnichnoi pidhotovlenosti rehbistiv na etapi spetsializovanoi bazovoi pidhotovky [Innovative technologies for improving the physical and technical preparedness of rugby players at the stage of specialized basic training]: avtoref. dys. na zdobuttia nauk. stup. kand. nauk z fiz. vykhovannia ta sportu: spets. 24.00.01. Dnipropetrovsk, 22 p. (in Ukr.).

8. Pasko, V. V., Podoliaka, O. B., Martyrosian, A. A., Fylenko, Y. Yu. (2012), " Analysis and determination of organizational aspects of the development of rugby league in Ukraine", Slobozhanskyi naukovo-sportyvnyi visnyk. No. 4, pp. 165-168. (in Russ).

9. Sabirov, O. (2012), "Formation and development of rugby in Ukraine". Molodizhnyi naukovyi visnyk. Seriia: Fizychne vykhovannia i sport. Vyp. 7, pp. 19-22. (in Ukr.).

10. Brian P. Soebbing, Marvin Washington (2011), "Leadership Succession and Organizational Performance: Football Coaches and Organizational Issues", Journal of Sport Management, Volume 25 (2011): Issue 6 (Jan 2011), pp. 550–561. (in Eng.).

11. Dwyer, B., Gregory P. Greenhalgh and Carrie W. LeCrom (2015), "Exploring Fan Behavior: Developing a Scale to Measure Sport eFANgelism", Journal of Sport Management, Volume 29 (2015): Issue 6 (Jan 2015), pp. 642–656. (in Eng.).

12. Quatman, C., Chelladurai, P. (2008), "Social Network Theory and Analysis: A Complementary Lens for Inquiry", Journal of Sport Management, Volume 22 (2008): Issue 3 (Jan 2008), pp. 338–360. (in Eng.).

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The authors are responsible for the reliability of the presented results

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