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METHODOLOGY OF BIOMECHANICAL MONITORING OF SPATIAL ORGANIZATION OF THE HUMAN BODY: JUSTIFICATION AND TESTING

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Abstract

Ihor Vypasniak, Nazarii Fedyniak. Methodology of biomechanical monitoring of spatial organization of the human body: justification and testing. SHEE “Vasyl Stefanyk Precarpathian National University”, Ivano-Frankivsk.

Relevance. Modern scientific methodology considers monitoring as a multifunctional tool that synthesizes observation, assessment and forecasting. The etymology of the word, which comes from the Latin monitor, indicates its main purpose – the implementation of supervision and control. Unlike general research, monitoring is characterized by focus, allowing to obtain objective empirical data for tracking the dynamics and evolution of the phenomenon under study.

Research tasks. To theoretically substantiate the system of biomechanical monitoring of the state of spatial organization of the body of students in the process of physical exercise.

Research results. The introduction of the author's correctional and preventive technologies was accompanied by a consistent control system. It included: preliminary control to assess the initial level; operational control to monitor the effectiveness of current actions; current control to assess the results after the completion of individual blocks and semesters; final control of the final assessment of effectiveness for the entire academic year; and self-control to constantly track the dynamics. When organizing the monitoring of the spatial

organization of the students' body in the process of physical education, we took into account the fact that it is necessary to have a set of information and methodological tools.

Conclusions. Monitoring as a scientific methodology is a comprehensive approach to collecting, analyzing and interpreting data reflecting the state and dynamics of the object of study. In scientific literature, the spatial organization of the human body is understood as a synergetic interaction of morphological and functional aspects, which is reflected in the external form. Thus, the creation of a methodology for biomechanical monitoring of this organization is an urgent scientific task, interdisciplinary in nature. The key feature of biomechanical monitoring of the spatial organization of the human body is its selectivity and target orientation, which allows for effective analysis aimed at specific tasks, as well as tracking the stages of development of the phenomenon under study.

Key words: biomechanical monitoring; spatial organization of the body; students; physical education; correctional and preventive technologies; posture.

Monitoring as a multifunctional tool of systematic analysis is based on a combination of observation, evaluation and forecasting [3, 8, 9]. Its etymology, coming from the Latin monitor, emphasizes its main purpose – supervision and control [10, 11, 20, 22]. Due to targeted analysis, it allows to obtain objective empirical data, which distinguishes it from general research [4, 18, 21]. This method is characterized by three key scientific features:

systemic nature: implementation through complex monitoring systems of the assessment of the state of the object, control of its dynamics and prevention of undesirable trends;

subject orientation: application in certain areas to specific objects or processes, which ensures the accuracy and relevance of the results;

duration: the ability to record the state of the object over a long period of time, which allows for the analysis of development trends and reliable forecasting [1, 18, 19].

The purpose of the study is to theoretically substantiate the modern paradigm of biomechanical monitoring of the state of the spatial organization of the human body during physical exercise.

Research objectives:

1. To study the current state of the problem under study, to generalize domestic and international experience of biomechanical monitoring of the state of spatial organization of the human body in the process of physical education.

2. To theoretically substantiate the system of biomechanical monitoring of the state of spatial organization of the body of students in the process of physical exercise.

Research methods. To accomplish the set tasks, an analysis of scientific and methodological literature and pedagogical methods were used.

Presentation of the main research material. In academic discourse, the spatial organization of the human body is defined as an integrated set of morphological and functional characteristics that manifest themselves in its appearance [12, 16, 17].

The desire to identify patterns in the dimensions of the human body arose in Ancient Egypt, but in ancient culture this idea evolved into the concept of physical and spiritual harmony. The era of Greek classical art was a period of intensive study of the human body, and the sculptures of Polykleitos and Myron are still considered examples of perfect proportions. The cult of beauty inherent in the ancient Greeks also had a pragmatic justification, since harmonious physical development was considered necessary for military affairs. In this context, ancient Greek culture was actively engaged in the search for mathematical laws underlying the beauty, harmony and ideal of the human body and spirit [6, 15, 16].

The Renaissance marks the peak of the study of the laws of spatial organization of the human body. One of the key discoveries was that harmonic proportions for ensuring the stability of the body are subject to the principle of the "golden section". This knowledge took a central place in the work of Leonardo da Vinci. His legendary drawing "Vitruvian Man", depicted in the work "On the Divine Proportion", became a symbol of the internal symmetry of the body. In it, a figure inscribed in ideal geometric figures demonstrates proportions calculated by a module equal to the height of the head [16].

In recent years, scientific data [2, 10, 14] confirm that biomechanical patterns of the spatial organization of the body play a key role in managing the interaction of the organism with the environment. This allows optimizing the processes of maintaining health, developing physical qualities and creating favorable conditions for life. The formation of the spatial organization of the human body is the result of the influence of both biological and social programs [5, 13, 20]. Foreign and domestic experience shows that special attention is paid to the study of functional disorders of the musculoskeletal system, in particular, posture disorders in the sagittal and frontal planes (scoliotic posture, round, flat back, etc.), which can cause the development of diseases of the spinal column [11, 20, 21].

It should be noted that the methodology of biomechanical monitoring of the spatial organization of the human body is a relevant and multifaceted scientific problem that requires

an interdisciplinary approach, combining knowledge of biomechanics, information technology and kinesiology [7, 23, 24].

Regulation of biomechanical monitoring of the spatial organization of the body of students is based on the following key conditions. Firstly, it should have a diagnostic and prognostic focus, which allows not only to assess the current state, but also to predict its dynamics. Secondly, it is necessary to ensure the reliability of the data by using standardized characteristics. Thirdly, monitoring should be systematic in order to track the dynamics of indicators and evaluate individual growth. In addition, the efficiency and availability of information, its pedagogical interpretation and effective use for making adjustments to the educational process are important. Finally, the success of monitoring depends on the consolidation of the efforts of all involved specialists.

When organizing the monitoring of the spatial organization of the students' body in the process of physical education, we took into account the fact that it is necessary to have a set of information and methodological tools.

The introduction of the author's correctional and preventive technologies was accompanied by a consistent control system. It included: preliminary control to assess the initial level; operational control to monitor the effectiveness of current actions; current control to assess the results after the completion of individual blocks and semesters; final control of the final assessment of effectiveness for the entire academic year; and self-control to constantly track the dynamics.

The preliminary stage uses preliminary control to determine functional disorders of the musculoskeletal system. An assessment is made of the biogeometric profile of posture, physical development and fitness, including endurance, strength, flexibility, speed, joint mobility and static balance. These data form an individual and group profile of students. Subsequently, progress assessment is based on changes in this profile, reflecting the improvement of the symmetry of the biokinematic chains of the body. This corresponds to the principle of the "golden section", which is followed by an ideally symmetrical body, like Leonardo da Vinci's "Vitruvian Man". Any deviation from symmetry indicates a disturbance in the spatial organization of the body. Maintaining the balance of the head, which accounts for 7% of the body weight, is critical for the regulation of the orthograde posture. This process depends on moderate cervical lordosis. Hyperlordosis, which occurs due to excessive tension in the neck muscles, reduces their strength, which leads to deformation of the chest. Asymmetry or weakness of the neck muscles has a negative impact on the functioning of vital organs and can impair cerebral circulation. The usual incorrect position of the head leads to

cascading changes in muscle tone throughout the body, which ultimately leads to postural disorders. The following methods were used to assess this condition at this stage: observation, oral control, tests and screening.

The introduction of corrective and preventive technologies was accompanied by multi-level control. At the corrective stage, operational and current control of monitoring progress in physical fitness and biogeometric profile of posture was used. The supporting stage included final control, which served as the final tool for assessing the effectiveness of the implemented technologies. Within the framework of this control, a comprehensive assessment of physical development, physical fitness, the state of the musculoskeletal system and functional disorders of the musculoskeletal system of students was carried out.

Throughout the year, students used the method of self-monitoring the level of physical fitness.

Prospects for further research will be related to the development of a system for biomechanical monitoring of the state of spatial organization of the body of women of the second mature period during health fitness classes.

Conclusions. Monitoring as a scientific methodology is a comprehensive approach to collecting, analyzing and interpreting data reflecting the state and dynamics of the object of study. This approach is a pragmatic method of obtaining empirical knowledge based on recording facts obtained through observations, experiments and other traditional procedures. In scientific literature, the spatial organization of the human body is understood as a synergetic interaction of morphological and functional aspects, which is reflected in the external form. Thus, the creation of a methodology for biomechanical monitoring of this organization is a relevant scientific task, interdisciplinary in nature. The key feature of biomechanical monitoring of the spatial organization of the human body is its selectivity and target orientation, which allows for effective analysis aimed at specific tasks, as well as tracking the stages of development of the phenomenon under study.

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