FORMATION OF SOME PSYCHOPHYSIOLOGICAL FUNCTIONS IN ATHLETES UNDER THE INFLUENCE OF PROLONGED PHYSICAL LOADS

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Summary. As a result of experimental studies, data were obtained regarding the individual typological properties of HNA, memory and attention functions, and correlations between them. Under the influence of long-term physical training, young men develop more intensively individual-typological properties of HNA, neurodynamic and psychomotoric functions, which make up the physiological and psychological basis for the success of mastering the skills of sportsmanship.

Keywords: higher nervous activity (HNA), physical activity, functional mobility of nervous processes, visual-motor reactions, memory, attention.

Success in sports largely depends on the individual psychophysiological properties of an athlete. One of the main directions of psychophysiological research is the study of the individuality of an athlete in the totality of properties related to different components of the life of the organism – morphological, biochemical, physiological, psychological, which characterizes the "integral individuality".

Specialists in physical education and sports point to the need to study and introduce into the practice of classes, trainings and sports competitions scientific developments on the study of individual typological properties of higher nervous activity (HNA), namely: the strength and functional mobility of nervous processes, as well as a number of mental properties [1].

Until now, knowledge about the relationship between the functional mobility of nervous processes (FMNP) and the strength of nervous processes (SNP) with the
effectiveness of sports achievements is insufficient and cannot satisfy the requirements of practice. Meanwhile, further study of these connections made it possible to get closer to a deeper understanding of this problem and use them in practice, possibly in the system of sports selection. In addition, the determination and consideration of individual typological properties, psychophysiological functions and personality traits of an athlete can become a factor that can significantly increase the effectiveness of the training process [2]. Of course, these questions are of interest not only to physiologists, but also to teachers, coaches, athletes, and doctors.

The relevance of this study lies in its focus on the study of the relationship of mental functions with the functions and properties of the central nervous system, the unity of the interaction of which ensures effective physical activity. The importance of these studies lies in the fact that it is the nervous system, its higher divisions, that plays the leading role in mobilizing the reserve capabilities of the autonomic systems, in the formation of various adaptive functions of the body.

The purpose of this work is to study the features of the formation of mental and individually typological properties in athletes aged 18-20 under the influence of prolonged physical exertion, their relationship and dependence on each other.

The object of the study were students (young men) of the 2nd-3rd year of the Luhansk National Taras Shevchenko University, the Faculty of Natural Sciences and the Institute of Physical Education and Sports. When forming the groups of examined students, we proceeded from a number of conditions that ensure the receipt of measurement results with a minimum error for subsequent statistical processing. In total, 40 people aged 18-20 years old took part in the study. The main group consisted of athletes who were engaged in physical training loads for 8-10 years. The control group consisted of students who were engaged in the usual program of physical education. The experiments were carried out with each group during November-January using the age cut method. During the examinations, the state of health was assessed using the medical records of the subjects. During the methodological examination of the examined students, there were no deviations in the somatic and mental status. According to the educational documentation, all students completed the curriculum.

Taking into account the changes in mental performance at the beginning of the working day and week, the studies were carried out on days of high mental performance – on Tuesday, Wednesday, Thursday on the second, third pair from 9 to 11 o'clock in the afternoon, when the optimal level of physiological functions is observed.

At the beginning of the study, each student was individually introduced to the whole range of psychophysiological research methods. In our study, we were guided by the opinion that when studying typological features, the duration of the experiments should be within 10–15 minutes and not exceed 30–40 minutes. The order of research for the entire surveyed contingent was carried out according to the same scheme. First, simple tasks were performed – testing memory and attention indicators using blank methods. Next, the latent periods of visual-motor reactions of varying degrees of complexity were studied. In conclusion, there were more complex methods – indicators of functional mobility and strength of the main
nervous processes using an instrumental technique [3].

When performing the work, the experimenter sought to create conditions close to natural. The following methods were used:

1. Methods for determining the properties of functional mobility and strength of the main nervous processes and sensorimotor reactions of varying degrees of complexity.

2. Methods for the study of visual and auditory memory.

3. Methods for the study of individual characteristics of attention.

The processing of numerical values was carried out by the same researcher on the same device, using the same blank methods. All studies were carried out on the basis of the Department of Anatomy, Physiology, Human and Animals of the Luhansk Taras Shevchenko National University.

Achieving high sports results in modern sports is associated with the ability of an athlete to withstand both great physical and significant neuro-emotional stress during training and competition. In this regard, the factor of differences between athletes, not only in terms of physical capabilities, but also in terms of the neurodynamic properties of the nervous system, is of no small importance for achieving high sports results [4].

In this regard, we conducted a study of the functional mobility and strength of nervous processes in students of the control group and athletes aged 18-20 under the influence of long-term physical training. The latent period of simple (LP SVMR) and complex visual-motor reactions (reactions of choice RCh) (LP RCh 1-3, LP RCh 2-3) was also measured (Fig. 1).

In the control group, in 18-20-year-old boys, the FMNP index was 101.3±1.95 stimuli/minute (p <0.001) versus 109.2±1.99 stimuli in athletes (p<0.001). Thus, the study revealed that the FMNP index in the young men of the sports group was higher than in the control group. The difference between the FMNP values in the control and sports groups was 7.9 stimuli/minute (p <0.01).

The results of the study of SNP revealed that the lowest values of SNP were observed in the control group, they accounted for 13.2±0.53% of errors, and in the
sports group – 10.0±0.36% of errors (Fig. 2).

Differences between the indicators of the control and sports groups are statistically significant (p <0.001).

We also assessed the dynamics of the HNA properties by changing the indicators of sensorimotor reactivity to the load during the processing of information of varying degrees of complexity. The nature of sensorimotor reactivity was determined by the duration of the latent periods of simple and complex visual-motor reactions.

The average values of LP SVMR in athletes were 222.3 ± 6.8 ms versus 264.1 ± 4.4 ms in the control (p <0.001). That is, athletes have a shorter latent period than students in the control group who do not experience prolonged physical exertion. The difference between the indicators is 41.8 ms.

The results of the dynamics of the average values of the latent periods of a complex visual-motor reaction (selection of one of three stimuli) LP RCh 1-3 in athletes averaged 310.9±8.5 ms against 340.0±9.3 ms in the control.

When registering a more complex reaction of choosing two positive signals out of three (LR RCh 2-3), the latent periods of responses became longer compared to the latent periods of simple ones and the reaction of choosing one of the three stimuli. In the students of the sports group, the latent period averaged 425.8±7.4 ms, in the control group – 460.9±9.8 ms (p <0.01). Analysis of these results showed that the speed of a complex sensorimotor reaction is affected by physical activity.

The differences that were observed between the parameters of the neurodynamic functions of the sports and control groups, in our opinion, should be explained by the influence of prolonged physical activity on the formation of these functions in ontogenesis.

In order to characterize the mnemonic function, short-term memory of various forms of modality was studied: auditory and visual. Using the same methods, an experimental study was conducted with students aged 18-20 separately from the control and sports groups. Comparison of mid-level estimates of memory functions of students of sports and control groups was made.

As a result of the research, statistically significant differences were revealed between the indicators of the volume and performance of auditory and visual memory for different types of material in young men of sports and control groups. The volume and performance of auditory and visual memory for various types of material in athletes throughout the study period were lower than the corresponding indicators in the control group.

Higher rates of short-term auditory and visual memory were found in young men in the control group than in young men who went in for sports for a long time. Thus, in the studied age period of ontogenesis, the volume of short-term auditory memory for words and numbers in athletes was 74.2±1.9 and 51.3±1.6%, respectively, and in boys of the control group – 84.2 ± 1.9% (p <0.01) and 61.9±1.9% (p<0.001). The productivity of auditory memory for words was 6.9±0.2 points in athletes versus 7.5±0.2 points in controls (p <0.05), for numbers, respectively, 5.2±0.2 and 6.8±0.2 points (p<0.001). Indicators of visual memory for words and numbers in the sports group were 82.6±1.9 and 60.0±2.5 points, respectively, against 91.6±1.6 (p <0.01) and 70.6±1.9 points (p<0.01) for students of the control
In parallel with the study of the dynamics of the formation of the memory function in students of the control and sports groups, we conducted a study of the processes of formation of their attention functions using several methods: Landolt rings, "red-black tables".

The results give grounds to state that there are differences in the average values of the attention switching indices (ASI), the total amount of information processing (TAIP), the speed of information processing (SIP) in the examined athletes and students who do not go in for sports. There were no statistically significant differences between the average values of attention switching indicators (ASI) of the two groups (p > 0.05). The average values of indicators of the volume (TAIP) and concentration (SIP) of attention were higher in the students of the control group (in athletes, TAIP 145.9 ± 2.8 bits against 154.6 ± 1.7 bits in the control; SIP of athletes 1.45 bits/s versus 1.64 bits/s in the control group).

Thus, training physical activity has a beneficial effect on the functional state of the nervous system in athletes aged 18-20, which creates additional opportunities for learning and physical training.

Although higher rates of verbal memorization are more characteristic of students in the control group. Such differences between the studied groups, in our opinion, are explained by the large study loads that students in the control group receive.

The research results suggest that long-term physical activity causes in athletes a complex restructuring of the central nervous system functions, which determine the identified changes.

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