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STUDY OF THE REACTIVE ABILITY OF THE NEUROMUSCULAR SYSTEM OF ATHLETES DURING INTERACTION BETWEEN THE REGULATORY AND EXECUTIVE PARTS

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Annotation. We have studied the reactive ability of athletes in the sensorimotor tests of various difficulty in connection with the main rhythms of the brain, examined interaction between the regulating and executing parts of the neuromuscular system of athletes. This interaction was rated by the strength and direction of the connections identified with the Spearman correlation analysis. The results are presented in positive connections of the average strength between the main rhythms of the brain (alpha, beta, theta rhythms, and the theta/beta rhythms ratio), the mimic muscle electromyography with the results of sensorimotor tests of various difficulty, showing different structural and functional levels of the brain engaged in the motor response support. Developing fatigue of the regulating and executing parts greatly correlates with a number of erroneous motor responses and an absence of motor responses with beta and theta rhythms, stress of the mimic muscles, decrease in strength of interaction with alpha rhythm of an athlete's brain.

Keywords: brain rhythms, neuromuscular system, reactive ability, athletes.

Introduction. The regulation of the purposeful motor activity of a person that contributes the adaptation of an athlete's body to the professional activity depends on the functional state of the motor system [1-4] and the ability to adapt morphofunctional changes of all level of body function to the specifics of sports activity. The reactive ability of the neuromuscular system in the form of motor response reflects plasticity and functionality of the muscular apparatus as the executive part. The state of the regulating part of the reactive ability demonstrates the functional state of neuron structures that support movement. The conclusion on the functional state of the neuromuscular system and the adaptive changes occurred during the professional activity would allow us to study the consistency of the interaction between the regulatory and executive parts of athletes in the study of the reactive ability [5].

Methods and organization. The state of the neuromuscular system's regulatory part in athletes was assessed by the main rhythms of the brain (alpha, beta, theta rhythms, the theta/beta rhythms ratio, Hz, %) on the

"BOSLAB" software and hardware complex (the BI-2 version, made in Novosibirsk). We have made the 10-minute recording with the subject's eyes open, in the Cz-Fz lead (according to the "10-20" International Classification, the indifferent electrode was placed on the earlobe). The electromyographic (EMG) stress of the mimic muscles was registered with the sensors placed on the forehead.

According to the reactive ability of the muscle and motor response of athletes, we have also examined the function of the executive part of the neuromuscular system on for stimuli of various difficulty using computer software [6]. We have studied the simple sensorimotor reaction (SSR), complex sensorimotor reaction (CSSR), average response time (ms) (SSR, CSSR), erroneous responses of the CSSR (total, number), and response absence of the CSSR (total, number).

The study of the registered indicators' interrelation with the Spearman correlation analysis has allowed us to identify the interaction between the regulatory and executive parts of the neuromuscular system (we considered

values of the average correlation coefficient ($r=\pm 0.3$ to ± 0.699) and high interaction strength ($r=\pm 0.7$ to $\pm 1 \geq 0.99$)).

Interaction between the regulatory and executive parts in the sensorimotor tests of various difficulty demonstrate the total level of the central nervous system's function, its performance and activity, the dynamics of nervous processes, the speed of athletes switching to different types of activities [7].

Results and discussion. When analyzing the SSR's average time, correlated with macro movements and provided by the pyramidal level of movement organization [7], we have found the average degree of interaction with the studied brain rhythms (Hz): with alpha rhythm ($r=0.4$), beta rhythm ($r=0.51$), theta rhythm ($r=0.44$), and beta rhythm (%) ($r=0.45$).

The analysis of the CSSR's average time that reflects the CNS's selective activity with the distinction of the presented signals and the choice of behavioral response methods [8], which is regulated exclusively by the cortical level of the CNS [10], has demonstrated an increase in the strength of interaction with the brain rhythms: with alpha rhythm ($r=0.5$), beta rhythm ($r=0.65$), theta rhythm ($r=0.5$), as well as decreased interaction with EMG ($r=0.38$). These dynamics may reflect the redistribution of excitation processes, the shift of stress from the executive (motor) part to the regulatory (CNS) part of the neuromuscular system of athletes when providing a more complex motor response.

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The occurrence of fatigue processes shows the occurrence of erroneous responses and the motor response absence in the CSSR, which was demonstrated in the interaction of the number of erroneous responses with the brain rhythms: with alpha rhythm ($r=0.4$), beta rhythm ($r=0.4$), theta rhythm ($r=0.52$) and the stress of the mimic muscles (EMG, $r=0.4$). The absence of responses to the signal significantly interacts with the beta ($r=0.75$) and theta rhythms ($r=0.8$), as well as with EMG ($r=0.8$), decreasing in the alpha rhythm ($r=0.5$). This, in whole, shows the occurrence of overstrain and fatigue in the neuromuscular system of athletes of both the regulatory (CNS) and the executive (muscular) parts, depending on the nature of local or generalized fatigue.

Conclusion. The analysis of the neuromuscular system's function based on the study of the interaction between the regulatory and executive parts during the examination of the reactive ability of athletes makes it possible to diagnose, control and predict the likely onset of negative psychophysiological processes, including fatigue associated with professional activity, affecting its efficiency [5, 6, 10-14]. Identifying the degree of interrelation between the regulatory and executive parts allows a reasonable approach to the choice of preventive and restorative means of the neuromuscular system of athletes during their professional activity.

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