Parameters of vibration imaging and psychophysiological reactions in highly qualified athletes specializing in bullet and bench shooting

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Abstract

Objective of the study was to determine the information content of the innovative vibraimage technology (VibraMed10, 2020), taking into account the psychophysiological indicators of the state of athletes.

Methods and structure of the study. In the course of scientific work, methods of vibraimaging and psychophysiological testing were used to analyze the current state of 58 highly qualified athletes specializing in bullet and clay shooting. A statistical analysis of the parameters of the vibraimage and psychophysiological reactions was carried out. The informative significance of the indicators determined when using the technology of vibraimage to assess the psychophysiological state of highly qualified athletes specializing in bullet and bench shooting has been determined.

Results and conclusions. The conducted pilot study indicates the possibility of using the technology VibraMed10 to monitor the psychophysiological state of athletes in the process of training and competitive activities. This is confirmed by the identification of common characteristics, such as "self-regulation", "energy", "charisma", "aggressiveness", "stress", "anxiety", "depression" and "danger", which are typical for shooting sports athletes in general. Along with this, differences were found in the severity of the parameters: "poise", "neuroticism" and "inhibition", which can be attributed to the priority signs of belonging to a narrow specialization.

Keywords: *highly qualified athletes, bullet shooting, bench shooting, vibraimage, psychophysiological testing.*

Introduction. In recent decades, modern methods of psychophysiological diagnostics have been actively developed in elite sports to assess the preparedness of athletes. Vibraimage technology is one of the innovative methods for improving psychophysiological diagnostics. As an indicator of the body's response to internal and external factors, the characteristics of the functioning of the vestibular system are used, which has multiple afferent and efferent morphofunctional connections with cortical-subcortical formations of the central and autonomic nervous systems of the brain and spinal cord, as well as with neuroendocrine processes [4]. The parameters of the vibraimage reflect the systemic reaction of the body, which already now allows you to quickly identify individuals with deviations or disorders of psychophysiological adaptation. Pilot studies on the use of vibraimaging technologies based on the VibraMed10 and MI-Sins programs (Elsis company, St. Petersburg) in elite sports in the first approximation showed the informativeness of this diagnostics and monitoring of the condition of highly qualified athletes [1, 6, 7]. However, the correlation of vibraimage data with the results of standardized psychophysiological methods used in sports practice has not been studied, which limits the application of the method.

Shooting, as a technical sport with complex coordination, differing in specific requirements for the psychophysical abilities of an athlete, is an adequate model for studying the activity of the central nervous system using vibraimage technologies.

Objective of the study was to determine the information content of the innovative vibraimage technology (VibraMed10, 2020), taking into account the psychophysiological indicators of the state of athletes.

Methods and structure of the study. The research was carried out on the basis of the Federal Scientific Center for Physical Culture and Sports. A comprehensive examination of 58 highly qualified sportsmen-shooters was carried out: 24 sportsmen - trap shooting, 34 - bullet shooting, with an equal number of men and women; age 18-36 years (mean age 22.8±4.4 years); sports qualification: 8 people - Honored Master of Sports, 24 people - International Master of Sports of Russia, 18 people - Master of Sports, 8 people - Candidate Master of Sports.

Testing included the use of vibraimage technology (VibraMed10, 2020) and psychophysiological methods "NS-PsychoTest" [3, 5].

The method of vibraimaging technology determines the psycho-emotional portrait of a person based on the results of frequency and amplitude analysis of the spatial and temporal movement of the head. The obtained movement parameters are converted using mathematical formulas into psychophysiological parameters with the allocation of emotional and psychophysiological states in percentages from 0 to 100%, which can be divided into four groups:

- the first group of conditionally negative emotional parameters includes: aggressiveness, stress, anxiety and the level of danger of this person to others;
- the second group includes conditionally positive emotional parameters: balance, charisma, vigor and self-regulation level;
- the third group of emotional parameters includes physiological parameters: inhibition, neuroticism, depression and the level of happiness;
- the fourth group consists of psychophysiological parameters: extraversion, stability, satisfaction, period of brain activity.

Among the standardized methods, a simple visual-motor reaction (VMR), complex reactions - a choice reaction (ChR) and a reaction to a moving object (RMO) were used. In the VMR test, the mean response time assessed the level of CNS functionality, and the standard deviation assessed cerebral homeostasis [2]. The ChR test evaluates the mobility of nervous processes: the average value of the reaction time reflects the general mobility of nervous processes with the diagnosis of inertness or mobility of nervous processes, the standard deviation evaluates stability [3].

Characteristics of psychophysiological state parameters (VibraMed10 method, APK NS-Psychotest) and type of specialization among high-skilled shooters, U Mann-Whitney

Index	Bullet shooting					Bench shooting					Bullet / bench shooting
	Men		Women		p	Men		Women		p	
Vibraimage	X	σ	X	σ		X	σ	X	σ		p
Aggression	42,6	2,4	43,4	3,9		44,0	8,6	40,5	6,4		
Stress	34,3	4,6	31,6	4,0		32,2	4,5	30,9	3,8		
Anxiety	31,5	3,4	30,1	4,0		30,8	3,3	28,9	6,3		
Danger	36,8	2,9	34,3	3,1	0,0005	35,5	2,2	34,7	2,5		
Equilibrium	69,5	10,0	71,7	11,1		78,1	6,0	80,1	4,2		0,00001
Charisma	59,5	12,1	67,8	8,0		54,2	10,3	58,0	11,4		0,024
Energy	22,3	7,2	21,9	5,9		21,2	2,9	23,4	5,2		
Self-regulation	64,1	8,9	69,2	7,6		65,8	4,1	68,8	5,7		
Braking	20,0	2,9	20,1	3,6		15,3	2,0	16,9	2,3	0,002	0,00001
neuroticism	26,4	4,8	28,8	5,4		34,1	7,3	37,7	8,9		0,0001
Depression	26,6	5,5	26,4	8,0		29,5	2,8	27,8	3,3		
Positive	53,9	7,9	57,6	7,1		54,8	3,6	57,6	5,4		
Negative	36,6	2,9	34,1	3,2	0,007	35,3	2,2	34,5	2,6		
Physiological	27,9	4,2	29,1	4,6		27,4	2,0	28,3	1,5		
Simple visual-motor reaction											
Average reaction time (ms)	204	14,9	213	34,9		188	15,7	187	21,4		0,0002
Standard deviation (ms)	45,7	15,3	42,3	13,7		34,2	11,4	34,8	11,2		0,001
Total number of errors	0,8	1,2	0,9	1,3		1,0	2,3	1,0	1,1		
Choice reaction											
Average reaction time (ms)	334	42,8	355	53,0		322	23,2	324	53,7		
Standard deviation (ms)	84,0	19,4	79,5	18,7		74,5	17,1	79,0	25,8		
Total number of errors	7,3	3,1	5,0	3,4	0,003	5,3	3,6	4,9	4,9		
Reaction to a moving object											
Average reaction time (ms)	0,9	17,0	-4,6	32,2		-2,1	14,1	-3,3	11,6		0,0002
Standard deviation (ms)	44,5	9,9	60,8	42,5		30,5	8,3	30,1	15,5		0,0005
Percentage of accurate reactions (%)	62,4	12,3	57,8	17,0		78,7	12,7	79,7	19,4		0,00001
Latency Percentage (%)	18,0	9,9	19,3	13,3		9,2	6,0	8,3	11,6		0,0001
Lead Percentage (%)	19,0	14,0	22,5	17,1		12,0	11,9	12,1	11,8		0,003

In the RMO test, to assess the balance of excitation and inhibition processes, the following were used: the average response time, standard deviation, the number of accurate reactions, delay and lead reactions (% of the total number of reactions) [8].

Results of the study and their discussion. A preliminary analysis of the test results showed that men and women of the same shooting specialization do not have significant differences in terms of psychophysiological state indicators, which made it possible to consider them as single groups representing athletes of both sexes in the "trap shooting" and "bullet shooting" groups (see table).

Comparative analysis of the results of the study of vibraimage and standardized psychophysiological methods between groups of shooters of different specializations showed that there are indicators that mark belonging to a specialization at the level of statistically significant differences. Thus, the "Skeet Shooting" group demonstrates a higher level of the "poise", "neuroticism" indicators and a lower level of the "inhibition" indicator, which also correlates with higher strength and stability of the central nervous system (VMR), greater reaction stability (ChR). It should be noted that the meaning of the term "neuroticism" in this method is interpreted as a measure of the stability of the "inhibition" indicator.

The results of the RMO test deserve special attention, indicating that athletes of both bullet and clay specializations are characterized by a balance of inhibition-excitation processes, however, the stability and frequency of reaction accuracy are fundamentally higher in the clay shooting group.

Conclusions. The conducted pilot study already at this stage indicates the possibility of using VibraMed10 technology to monitor the psychophysiological state of athletes in the process of training and competitive activities. This is confirmed by the identification of common characteristics, such as "self-regulation", "energy", "charisma", "aggressiveness", "stress", "anxiety", "depression" and "danger", which are typical for shooting sports athletes in general. Along with this, differences were found in the severity of the parameters "poise", "neuroticism" and "inhibition", which can be attributed to priority signs of belonging to a narrow specialization.

In trap shooting, the parameters "poise" and "neuroticism" reflect the general mobility of nervous processes, stability, balance of nervous processes and correlate with the results in the ChR and RMO tests. The "inhibition" parameter is manifested in the assessment of the level of functional capabilities of the central nervous system, the balance of excitation and inhibition processes in the VMR and RMO tests.

Further research of highly qualified athletes of various sports will allow forming the information field of the method, supplementing and verifying individual concepts in order to use them in the scientific and methodological support for the training of athletes of the national teams of the country.

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