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PECULIARITIES OF DIAGNOSTICS OF PSYCHOPHYSIOLOGICAL STATES IN ELITE ATHLETES

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Abstract. *The diagnostics of psychophysiological states may investigate: the individual typological characteristics of higher nervous activity, the process of formation and improvement of specific skills, fatigue and overstrain in athletes. It were examined 24 elite athletes, 20-25 yearsold members of National team of Greco-Roman Wrestling. It were examined the neurodynamics functions of nervous system and parameters of autonomic regulation of the heart rhythm in wrestlers were examined. The results show that the growth rate of sensory-motor response of wrestlers is accompanied by psychomotor tension, which leads to the stability of visual reaction. The rate of sensory-motor response has communication with the tension of regulation of heart rate, which is consistent with a decrease in the duration and frequency of the oscillations cardio-intervals of athletes with high speed of sensory-motor response. The psychophysiological diagnostics in elite wrestlers are characterized by the three components of the functional states: sensory-motor response, neurodynamics characteristics and heart rate regulation.*
Keywords: *diagnostics, psychophysiological state, elite athletes*

Introduction: The study of adaptation process of elite athletes in condition of increasing intensive of physical and psycho-emotional loads are directed to modern stage of sports science.

The functional states of athletes reflect the integral complex of functional system elements which are responsible for the effectiveness of activity. The psychic reactions of athletes in physical activity conditions cause the psychophysiological changes [1]. Due to this circumstance the diagnostic of psychophysiological states of athletes is one of the important ways of modern sports science. There are many works devoted to psychological diagnostics [2, 3], influence of physical performance on cognitive functions [4], emotional states [5], arousal [6], anxiety [7] and emotions [8] in athletes.

However, the modern ways of diagnostics of functional states of athletes are ignoring the complex criteria of psychophysiological components.

The one of the main properties of psychophysiological functions of athletes is the perception of sensory information. The several factors which characterize the efficiency of sporting activity: afferent component of information processing (reception and perception of information), central component (information processing) and efferent component of information processing which are influenced to the psychophysiological response of athletes [9, 10].

With the increasing of qualification of athletes the speed of visual response is increased in order of the magnitude. At the same time, in the competition the manifestation of neural and psychomotor abilities of athletes depends on the psychophysiological state of the organisms [11].

The system of vegetative regulation of heart rate is one of the key components of functional states of human in tension muscular activity. The results of relation investigation between psychophysiological reaction and vegetative regulation of heart rate during extremely activity are presented in the literature sources [12, 13].

The psychophysiological diagnostics gives additional information for functional states of athletes.

The first, psychophysiological functions are biological fundament of individual and typological functions of higher neural system and may be used in different diagnostics of human functional states.

The second, psychophysiological functions are characterised by the processes of forming and improvement of special experience which integrates the state of functional system, by technical performance of athletes.

The third, functional states of psychophysiological functions are a sensitivity indicator of fatigue and hypertension of athletes.

The aim of investigation: to point out the peculiarities of diagnostics of psychophysiological states in elite wrestlers.

Methods: were examined 24 elite athletes (Greco-Roman Wrestlers). The age of the athletes was 20-25. All of the athletes were the members of Ukraine National Team of Greco-Roman Wrestling.

The peculiarities of sensory-motor response were studied on individual-typological characteristics of nervous system by computer complex "Multipsychometer-05". Were used the optimal regime and regime of imposed rhythm. The methods: balance of nervous process by response to a moving object and tapping-test were used. The parameters: frequency of touches, liability, stability, accuracy and excitation were studied.

The analysis of non-stationary transient system of regulation of heart rate analysis the scatterograms as a non-parametric method of analysis was used [14]. There were determined the parameters SD1 (display aperiodic fluctuations of heart rate) and SD2 (slow oscillations of the heart rhythm).

All of the athletes were divided in two groups depending on level of sensory-motor response:

– first group athletes with higher level of sensory-motor response, with the value of the latent period of a simple visual-motor response from 120 ms to 240 ms, this group was joined by 10 people;

– the second group – the athletes with an average level of sensory-motor response speed, with value of latent period of a simple visual-motor response of 240 ms and over. This group was of 14 people.

Analysis of the success of competitive activities of athletes revealed that the first group of athletes with high-speed sensory-motor response at the time of the study and had the best indicators of the effectiveness of technical actions (by video analysis) [14].

The estimation of autonomic regulation of the heart rhythm was performed using cardio-monitor "Polar-RS800-CX" with the registration of the spectral characteristics of heart rate.

Statistical significance was assumed for $p<0.05$. Statistical analyses were performed with STATISTICA 6.0 software (StatSoft Inc., USA).

Results and discussion

The median of latent period of simple visual reaction of wrestlers with different level of sensory-motor response are presented in tab.1. As a seen the tab.1 the meanings of visual reaction of wrestlers with higher level of speed of sensory-movement response more quality significantly for comparing to wrestlers with low level.

Low meanings of stability of reaction of athletes with higher level of speed of sensory-motor response are related with increasing tension of psychomotor regulation in comparison with athletes with low level of sensory-movement response.

Table 1. Latent period of simple visual-movement reaction in wrestlers with different level of sensory-movement response (n=24)

Speed of response	latent period of simple visual reaction, ms			Stability of reaction, %		
	Median	lower quartile	upper quartile	Median	lower quartile	upper quartile
Higher	259,85	246,01	272,50	14,03	10,30	16,50
Low	300,45*	280,43	325,05	17,05*	13,30	24,30

**- p<0,01, in comparison with wrestlers with higher average speed of response*

Thus, high speed of sensory-motor response in wrestlers related with tension of psychomotor regulation and reaction's stability.

The data of tapping-test of wrestlers with different level of sensory-movement response are presented in Table 2.

The results of the study by the method of tapping-test showed that athletes with a high level of sensory-motor response speed has more qualitative characteristics compared with athletes with low-level sensory-movement response.

***Table 2.* Parameters of tapping-test in wrestlers with different level of sensory- movement response (n=24)**

Parameters	Higher speed of response			Low speed of response		
	Median	lower quartile	upper quartile	Median	lower quartile	upper quartile
The frequency of touches, secret unit	6,76	6,30	7,18	6,05*	5,55	6,65
Liability, secret unit	51,40	49,20	58,15	37,45*	36,75	53,10
Duty cycle, secret unit	2,80	2,55	3,08	4,20*	3,09	4,50
Stability, %	9,85	9,17	16,55	11,75*	10,80	17,05

**- p<0,01, in comparison with wrestlers with higher average speed of response*

The same difference is observed in the increase of frequency of touches in athletes with a high level of response rate. This fact indicates the improvement of the functional state of the neuromuscular system and the speed of nerve impulse (Table 2).

The wrestlers with low level of sensory-motor response are showing the reduction meanings of liability and duty cycle during tapping-test. The presence of higher absolute values of the coefficient of variation of wrestlers with low speed sensory-movement responses indicates deterioration in the stability of frequency of touches during the tapping-test.

Thus, the decline in the rate of sensory-movement response of wrestlers relates with the deterioration of the functional state of the neuromuscular system.

The data of balance of nervous process of wrestlers with different level of sensory-motor response are presented in Table 3.

Table 3. Balance of nervous process in wrestlers with different level of sensory-movement response (n=24)

Parameters	Higher speed of response			Low speed of response		
	Median	lower quartile	upper quartile	Median	lower quartile	upper quartile
Accuracy, secret unit	3,40	2,70	3,60	3,05	2,65	3,90
Stability, %	2,70	2,60	4,02	4,60*	3,00	6,45
Excitation, secret unit	-1,20	-3,18	-0,39	-0,93	-1,60	-0,61
Trend on the excitation, secret unit	-243,70	-442,30	-11,80	-303,10	-427,55	-188,40

**- p<0,01, in comparison with wrestlers with higher average speed of response*

The wrestlers with a high level of sensory-movement response has tendency to excitation of nervous system, compared with a group of athletes with a low level of sensory-movement response.

The study of heart rate variability has made it possible to differentiate the athletes with different levels of sensory-movement response speed, in

terms of autonomic regulation.

The results of the studies of heart rate variability in wrestlers with different levels of sensory-movement response speed are presented in tab.4.

The data of tab.4 reflects of the statistical difference between both groups of wrestlers by the mean duration of RR-intervals and SD2 parameters.

Thus, the rate of sensory-motor response of athletes has mediated relationship with the duration and frequency of the oscillations of heart rhythm.

As a seen Table 4 in wrestlers who has low level of sensory-motor response the presents the increase of aperiodic frequency of RR-intervals (for SD2 parameters).

Table 4. Statistical parameters of heart rate variability in wrestlers with different levels of sensory-movement response

Parameters	Higher speed of response			Low speed of response		
	Median	lower quartile	upper quartile	Median	lower quartile	upper quartile
Mean RR, ms	967,45	917,20	1083,05	1159,50*	1008,70	1221,40
STD, ms	96,45	61,95	138,35	110,10	99,40	123,40
SD1, ms	72,45	38,35	100,20	64,40	55,00	66,30
SD2, ms	130,85	82,500	180,65	167,40*	141,10	168,90

*- *p<0,01, in comparison with wrestlers with higher average speed of response*

This fact illustrates a growth of level of tension of heart rate regulation in athletes with a high level of sensory-movement response.

The data of spectral characteristics of heart rhythm in wrestlers with different level of sensory-movement response are presented in Table 5.

The result of Table 5 illustrates the more high level of HF parameters in wrestlers with low levels of sensory-movement response. This fact indicates the activation of parasympathetic tone of the autonomic regulation of heart rate in this group of wrestlers.

Table 5. Spectral characteristics of heart rhythm in wrestlers with different levels of sensory-movement response

Parameters	Higher speed of response			Low speed of response		
	Median	lower quartile	upper quartile	Median	lower quartile	upper quartile
VLF, ms^2	5275,00	1267,50	10095,00	7088,00	4802,00	10398,00
LF, ms^2	2444,50	1674,00	3704,50	2428,00	2395,00	2767,00
HF, ms^2	1092,50	600,00	3512,50	2373,00*	1959,00	2586,00
LF/HF	1,91	1,308	2,65	1,41*	1,01	1,51

*- *p<0,01, in comparison with wrestlers with higher average speed of response*

The increase of autonomic balance (LF/HF) of wrestlers with high level of sensory-motor reaction indicates a growing intensity of autonomic regulation of heart rate at the expense of activation of parasympathetic tone (Table 5).

Thus, the rate of sensory-movement response has mediate relation with the regulation of the heart rate tension at the expense of parasympathetic tone, which is consistent with a decrease in the duration and frequency of the oscillations cardio in wrestlers with high speed sensory-movement response.

This result is consistent with the our previously dates which showed a reduction in the accuracy and speed of movements according to the test performance with activation of sympathetic nervous system [15].

Conclusion

1. The psychophysiological states in elite wrestlers are characterized by the three components: sensory-movement response, neuro-dynamics characteristics and heart rate regulation.

2. The results has showed the increasing of duration aperiodic oscillation of RR-intervals in athletes with higher level of sensory-motor response. This fact may use as prognosis the functional states of wrestlers. The reduction of aperiodic fluctuation of RR-intervals is indicated on the violation of heart rate regulation.

3. The increasing level of sensory-motor response has communication with the tension of regulation of heart rate at the expense of parasympathetic tone. These peculiarities indicate on possibilities of increasing of functional reserves of the wrestlers. One of the ways of this increasing is orientation training process of wrestlers on the short-term intense exercise with a complex coordination.

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