IPsychophysiological characteristics of teenage athletes in cyclic sports

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Abstract

Objective of the study is to identify the psychophysiological status of teenage athletes involved in cyclic sports.

Methods and structure of the study. The work assessed the psychophysiological characteristics of 85 teenage athletes in cyclic sports: biathlon, speed skating and swimming using the psychophysiological testing device UPFT-1/30 – «Psychophysiologist». The level of reactive and personal anxiety was also determined.

Results and conclusions. The results of the study made it possible to obtain a psychophysiological portrait of teenage athletes involved in cyclic sports. We showed that biathletes had better work efficiency, strength and endurance of nervous processes. In swimmers, inhibition processes prevailed over excitation processes and were characterized by greater mobility. The number of accurate reactions among the athletes we studied turned out to be below the age norm, which is associated with the low dynamics of the competitive situation in these sports. Thus, the data obtained can be used in the training process and in preparing teenage athletes of cyclic sports for competitions.

Keywords: *psychophysiological characteristics, teenage athletes, cyclic sports.*

Methods and structure of the study. The scientific work was carried out in the 2022-2023 academic year, and involved teenage athletes aged 11-14 years who were involved in biathlon (26 boys), speed skating (30 boys) and swimming (29 boys) in sports schools in Kirov. The work was carried out at the resource base at the Federal State Budgetary Educational Institution of Higher Education «Vyatka State University» in the morning, with the consent of parents and the coach, in compliance with the principles of uniformity of requirements and confidentiality.

The assessment of the psychophysiological status of teenage athletes was carried out using the psychophysiological testing device UPFT-1/30 and included an assessment of a number of psychomotor indicators: A) assessment of the strength of nervous processes by measuring the dynamics of the tempo of movements of the subject's hand, which was carried out using the express method " Tapping test"; B) assessment of the functional state of the central nervous system according to the parameters of a simple visual-motor reaction (SVMR), which characterizes the level of activation of the central nervous system; C) assessment of the athlete's ability to adequately perceive changes in spatio-temporal events, as well as individual characteristics of the organization of the nervous system in terms of speed and accuracy of response to a moving object, namely the balance of the nervous system in terms of the degree of balance of excitation and inhibition processes, which were carried out according to the parameters of the reaction to a moving object (RDO). In addition, the athletes were assessed for reactive (situational) and personal anxiety using the Spielberger-Hanin scale.

Results of the study and discussion. One of the informative indicators used to assess the properties of the nervous system of athletes is the tapping test [6].

In our study, the tapping test was performed for 30 seconds first with the right hand and then with the left. Based on data on the duration of time intervals between impacts and the number of impacts for each 5-second interval, the following indices were

calculated: nervous system efficiency (NS), nervous system strength (NS), and nervous system endurance (NS) [5]. We have shown that biathletes had the greatest work efficiency, their frequency of impacts in 5 s was 6,11±***0***,029 times, and the lowest efficiency was among speed skaters (5,63±0,051 times, p≤0,05) (Table 1). Based on the results obtained, biathletes had the greatest strength of the nervous system (1,02±0,004), while speed skaters and swimmers had significantly lower values of this indicator (1,00±0,006 and 0,99±0,004, respectively), i.e. It was easier for biathletes to endure intense and long-term competitive and training loads, and they also needed less time to recover after such loads (Table 1). The nervous systems of biathletes (0,92±***0***,005) and speed skaters (0,91±0,005) had the greatest endurance, while in swimmers this indicator was significantly lower (0,88±0,004, p≤0,05, Table 1). Thus, the biathletes we studied had better work efficiency, strength and endurance of nervous processes, which gives them a greater opportunity to successfully perform in competitions and effectively carry out the training process.

The results of a simple visual-motor reaction indicate that the average reaction time and its standard deviation are significantly less in swimmers, and this indicates greater mobility of nervous processes and better development of the motor quality of speed. Whereas, the lowest mobility was noted among speed skaters (Table 2).

According to V.D. Nebylitsina (1996) the maturation of the visual sensory system ends by the age of 12-13, which contributes to improved orientation in space and coordination of movements [3]. Our PVMR data are consistent with similar results from L.A. Girenko et al. (2012), obtained for cross-country skiers of pubertal age and amounting to 227±5,1 ms [1].

To assess the individual characteristics of the organization of the athlete's nervous system, the reaction to a moving object test was used. Based on the obtained results of such indicators as: the percentage of advances, the sum of times of advances and the balance coefficient for the swimmers we studied, the processes of inhibition prevailed over the processes of excitation. Whereas, among biathletes and speed skaters, excitation processes predominated, this indicates that biathlon and speed skating develop an anticipatory strategy in young athletes. The contingent we studied did not differ significantly in the number of accurate reactions, which turned out to be below the age norm (4-6 accurate hits are normal), which is due to the specifics of cyclic sports, in particular, the low dynamics of the competitive situation (Table 3).

Studying the level of anxiety of athletes is an important component of their pre-competition preparation. The presence of anxiety in athletes is not a negative personality trait or a factor in failure in competition. According to the results of our study, the level of situational anxiety, which is responsible for the mental state of the athlete at a given point in time, corresponded to optimal values for the entire study population (Table 4).

Table 1 *– Indicators characterizing the properties of the nervous system according to the tapping test in adolescent athletes involved in cyclic sports, M±m*

Kinds of sports	Average beat frequency (number):		Sum of blows (number)		Efficiency index	Strength index	Endurance index
	right	left	right	left			
B n=26	6,1±0,03	5,4±0,04	183,3±0,85	162,4±1,06	6,11±0,029	1,02±0,004	0,92±0,005
SS n=30	5,5±0,001	5,2±0,09	178.3±2,01	157,6±2,79	5,63±0,051	1,00±0,006	0,91±0,005
S n=29	6,0±0,04	5,1±0,07	178,9±1,17	152,9±2,04	5,97±0,039	0,99±0,004	0,88±0,004
p<0,05	SS – B, S	B – SS, S	B – SS, S	B – S	B – SS, S; S – SS	B – SS, S	S – B, SS

Note: the differences between sports are significant: B – biathlon, SS – speed skaters, S – swimmers.

Table 2 – Indicators of simple visual-motor reaction in adolescent athletes involved in cyclic sports, M±m

Kinds of sports	ART (ms)	RMSD RT (ms)	Me (ms)	Mo (ms)	AMo (%)	min RT (ms)	max RT (ms)
B n=26	238,0±3,98	65,9±4,38	218,9±2,82	70,3±2,44	28,4±0,37	172,3±2,48	590,3±38,43
SS n=30	248,8±3,15	73,2±3,23	232,5±2,92	72,1±2,46	23,4±0,49	167,4±1,37	613,0±29,66
S n=29	223,5±2,00	49,9±2,71	212,8±1,56	66,1±1,75	30,8±0,64	160,5±0,79	474,9±24,52
p<0,05	B – SS, S; SS – S	S – B, SS	SS – B, S	–	B – SS, S; SS – S	S – B, SS	S – B, SS

Note: ART is the average reaction time, RMSD VR is the standard deviation of the reaction time, Me is the median, Mo is the mode, AMo is the amplitude of the mode, min RT is the minimum reaction time, max RT is the maximum reaction time. The differences between sports are significant: B – biathlon, SS – speed skaters, S – swimmers.

Table 3 *– Indicators of reaction to a moving object in teenage athletes involved in cyclic sports, M±m*

Kinds of sports	Number of exact reactions (number)	Lead percentage (%)	Sum of advance times (ms)	RMS deviation from ideal VR (ms)	Reaction coefficient to a moving object	Balance coefficient
B n=26	0,3±0,06	44,4±1,52	837,1±49,82	79,2±2,70	0,9±0,07	0,8±0,07
SS n=30	0,2±0,04	48,6±1,21	951,3±47,38	87,1±3,00	0,6±0,04	0,7±0,04
S n=29	0,4±0,07	38,3±1,09	736,2±24,81	78,0±2,07	1,2±0,06	1,4±0,05
p<0,05	SS – S	B – SS, S; SS – B, S, SS – S	SS – S	SS – S	B – SS, S; SS – S	S – B, SS

Note: The standard deviation from the ideal RT is the standard deviation from the ideal reaction time. The differences between sports are significant: B – biathlon, SS – speed skaters, S – swimmers.

Table 4 *– Indicators characterizing reactive and personal anxiety in teenage athletes involved in cyclic sports, M±m*

Kinds of sports	RA (point)	Above normal (%)	PA (point)	Above normal (%)
Biathlon (n=26)	33,1±0,59	none	37,1±0,66	38,5±9,54
Speed skaters (n=30)	34,0±0,78		40,3±0,87	50,0±9,13
Swimmers (n=29)	32,8±0,51		36,6±0,48	20,7±7,52
p<0,05	–		–	SS – S

Note: RA – reactive anxiety, PA – personal anxiety. The differences between sports are significant: B – biathlon, SS – speed skaters, S – swimmers.

However, the level of personal anxiety, which characterizes an individual's greater exposure to stress factors, was significantly higher among speed skaters.

Conclusions. The results of the study made it possible to obtain a psychophysiological portrait of teenage athletes involved in cyclic sports. Biathletes had better performance, strength and endurance of nervous processes. In swimmers, inhibition processes prevailed over excitation processes and were characterized by greater mobility. The number of accurate reactions among the athletes we studied turned out to be below the age norm, which is associated with the low dynamics of the competitive situation in these sports. Thus, the data obtained can be used in the training process and in preparing teenage athletes of cyclic sports for competitions.

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