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## **VEGETATIVE REGULATION OF THE HEART RHYTHM OF CHILDREN LEARNING KARATE**

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**Key terms:** young athletes, vegetative regulation, heart rhythm, karate

**Annotation.** The problems of adaptation of young athletes to physical loads in karate have been studied. The reaction of the cardiovascular system is reflected to different types of training: speed, technical-tactical, endurance development. Speed training loads cause satisfactory adaptation in all groups, taking into account the initial tone. Training loads associated with the development of the accuracy of technical actions in young athletes cause the asymptotic manner of reactions as a response. Training loads aimed at the development of special endurance were noted with a satisfactory response among "vagotonics" and "normotonics", signs of tension were found among "sympathicotronics".

**Introduction.** Analysis of the heart rhythm variability (HRV) is still relevant to sports medicine and sports physiology, despite numerous studies and publications on this topic [2, 6, 7]. It is due to the fact that the definition of HRV special features is considered as the manifestation of adaptation of athletes to physical loads in various sports [2, 3, 5]. The age from 12 to 16 years is one of the critical periods of ontogenesis. Critical periods serve as turning points in the process of ontogenesis, the beginning of a new stage of development, characterized by significant, qualitative transformations that occur simultaneously in various physiological systems. In the given age period, the level of functioning of the vegetative regulation of the heart becomes more perfect, but there is also unevenness in special features of the formation and stress degree of regulatory mechanisms [4, 5, 7]. The evaluation of responses of an organism of a young athlete to training loads is important to prevent risk of risk of overstraining, depletion of adaptation mechanisms and the development of pathological abnormalities in adolescents [7].

The purpose of the study. To examine vegetative regulation of heart rate of 12 years old boys, who do karate.

**Methods and organization.** The heart rate variability was analyzed using the hardware and software complex “Neurolab” (made by “Neurosoft”). Such indicators of variable heart rate monitoring were assessed: mode (Mo); mode amplitude (AMo); range (R); stress index (SI). Evaluation of the initial vegetative tone (IVT), regulation and stress degree of adaptation mechanisms and vegetative reactivity (VR) was carried out using the R.M. Baevskij’s method [1]. Sixteen athletes of the initial training group of the third year of training, who do karate, whose age at the moment of the study was 12 years, participated in the study. Three types of training sessions 90 minutes long were analyzed. Every training consisted of the preparatory part (warm-up included walking, steady running, running from various initial positions, acceleration, calisthenic routine, joint gymnastics), the main part (exercises and tasks in order to solve training tasks) and the final part (exercises for recovery and stretching). The aim of the first training session was to develop speed. The main part included exercises with a partner, with focus mitts; speed actions made with hands; running on a spot at the maximum pace; one-way relays with the elements of technical actions of a karateka. The second type of training was aimed at the development of technical and tactical actions (TTA) of a karateka. The main part included exercises from “Kata” and “Kumite” sections in the full equipment of a karateka. The techniques of performing stands, strikes, blocks, attacks with the upper and lower extremities separately; the technique of throwing, defensive actions, synchronicity of movement of athletes, stability in single-support positions were practiced; a sparring match was conducted. The third type was the development of general endurance. The main part included exercises of general physical training, sports game with “Rugby” elements. The analysis of the current state of young karatekas as a response to training loads was conducted considering the initial vegetative tone. The assessment of the HRV was conducted before (in the state of relative rest) and after the training (during urgent recovery). Mathematical processing of study’s results was carried out using the “Statistica” software. To compare independent variables the nonparametric Mann-Whitney criteria was used.

**Results and discussion.** The analysis of the initial vegetative tone of young karatekas was conducted in the state of relative rest. In the group of young karatekas, children with the initial type of regulation of vagotonia, normotonia, and sympathicotonia were identified. The predominant type of the vegetative regulation of the cardiovascular system is the vagotonic type. Indicators of IVT of vagotonic athletes have significant differences from those of athletes with sympathicotonic and normotonic types of regulation (Table 1).

As a result of the study, the multidirectional manner of changes in the departments of the autonomic nervous system of athletes to training loads was determined (Table 2).

The training aimed at the speed development in the group of “sympathicotonic athletes” and “normotonic athletes” caused responses of the athletes' organism corresponding to the optimal functioning of functional systems (VR was 0,6 and 1 s.u., respectively). In the group of “vagotonic” karatekas, significant changes in the direction of increasing HR, AMo and SI were registered. Index of VR of athletes was 10,6 s.u., which was characterized by the hypersympathicotonic reaction of the autonomous system to training loads (Table 2).

Table 1

The initial vegetative tone of 12 years old athletes

HRV indicators	Sympathicotonics (S), n=4	Normotonics (N) n=4	Vagotonics (V) n=8	P
HR, beats.min	99,1± 1,1	82,9±3,9	66,0±2,7	p<0,05*
Range, ms	222,0±3,0	347,5±78,5	873,2±123	p<0,05*
Mode, ms	625,0±0,1	725,0±0,1	791,7±81,3	p>0,05
Mode amplitude, %	46,8±2,7	23,45±1,35	18,3±1,88	p<0,05*
Stress index (SI), s.u.	169,0±12,1	68,0±12	13,2±2,19	p<0,05*

Note: \* - significance of differences between groups (S-N; N-V; S-V)

The second training, aimed at the TTA development of a young karateka, caused an increase in HR, BP AMo and a decrease in SI in the group of "vagotonics". Karatekas with the initial normotonic tone were characterized by a decrease in HR, AMo and SI after the end of training. Young karatekas with the sympathicotonic tone of regulation, similar to previous athletes, were characterized by a significant decrease in HR, AMo and SI. The SI in this group of athletes, compared to a similar one, decreased to 20,8 s.u. It is important to note that the analysis of VR in all groups of athletes did not exceed 0,2 s.u., which corresponded to the asymptotic reactivity of the processes of vegetative regulation of the heart rhythm.

The third training was organized after two days of rest and was aimed at the endurance development. Changes of registered indicators were noted with an insignificant increase or decrease in comparison with previous training sessions in the micro cycle. The simultaneous increase of AMo and SI indicators as a response to physical loads is noted in the group of the vagotonic type of regulation. VR in all analyzed groups was within 0,9-1,0 s.u., which is characterized by the

sympathicotonic reaction of an organism to training loads. However, signs of adaptive reaction stress were noted in the group of young karatekas with the sympathicotonic type of vegetative regulation: AMo and R values were decreased.

Table 2

Indicators of cardiointervalography before and after physical loads (taking the initial vegetative tone of young karatekas into account)

Type of training		HR, beats/min	Range, ms	Mode, ms	Mode amplitude, %	Stress index (SI), s.u.	VR	
sympathicotonics								
Training 1: speed development	before	99,1± 3,0	222,0±3,0	625,0±0,1	46,8±2,7	169,0±12,1	0,6	
	after	103,2 ±0,9	644±368	575,0	51,8±2,3	106,4±63,9		
	normotonics							
	before	82,9±3,9	347,5±78,5	725,0±0,1	23,5±1,35	68,0±12	1,5	
	after	92,1 ±1,8	328± 22	691±34	27,95±3,45	100,5±1,3		
	vagotonics							
before	66,0±2,7	873,2±123	791,7±81,3	18,3±1,88	13,2±2,19	10,6		
after	87±8,1	458,7 ±97,7	708,3 ±84,3	44,1 ± 12,2	140 ± 69,2			
sympathicotonics								
Training 2: TTA development	before	77,8±9,1	409,5±198,5	775±100	57,4±20,7	108±93,2	0,2	
	after	71,1±3,9	898±135	616±41	23±0,1	20,8±1,4		
	normotonics							
	before	92,1±23,5	284,5±87,5	725±200	50,1±14,4	182±130,1	0,1	
	after	70,1±8,0	801,5±356,5	825	19,8±2,3	20±10,5		
	vagotonics							
before	79,7±2,9	496,2±98	783,3±32,8	26,7±0,8	44,1±6,7	0,1		
after	83,9±4,9	547,3±102	733,3±37,5	23,2±3,0	37,7±12,6			
sympathicotonics								
Training 3: endurance development	before	106±0,4	242,5±62,5	575	56,6±1	216±51,9	0,9	
	after	108±1,4	277,5±27,2	550±17,7	61,6±2,3	209,7±34,5		
	normotonics							
	before	89,6±9,6	426,5±99,5	725±200	34,1±17	72,4±53	1,0	
	after	89,1±12,1	488,5±164,5	650±75	32,3±16,3	73,6±56,7		
	vagotonics							
before	89,8±4	340,2±32,9	688±38,4	31,1±2,1	72,4±12,5	1,0		
after	89,5±5,4	524,8±118	641,7±22,6	23,4±6,3	75,8±28,4			

**Conclusion.** Thus, training sessions used in the process of training of young karatekas had distinctive features of manifestation of organism's responses to stress factor (which are loads). The features of the responses are associated with the initial vegetative tone, with the heterochronous formation of structures of the autonomous vegetative system. Training loads of speed manner cause a satisfactory

adaptation in all representatives of the groups. Great shifts were registered among those with the vagotonic tone, less ones – among karatekas, who have the sympathotonic type of regulation. Training loads aimed at the development of tactics and the technique of movements cause the asymptotic manner of reactions as a response among young karatekas. Training loads aimed at the endurance development were noted with satisfactory response among “vago-tonics” and “normotomics”, signs of stress of the adaptation mechanisms were registered among “sympathicotomics”.

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