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FUNCTIONAL STATE OF THE AUTONOMIC NERVOUS SYSTEM IN CHILDREN 11-16 YEARS OLD IN SPORTS

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Annotation. During the study, the functional state of the autonomic nervous system was evaluated in children 11-16 years old, who do and do not do sports. The study involved young athletes (n = 100) and adolescents not involved in sports (n = 104). It was revealed that an additional mode of motor activity (training 5 times a week) positively affects the formation of regulatory mechanisms in adolescents 11-16 years old, accelerates the maturation of adrenergic regulatory mechanisms. The usual mode of motor activity (physical culture lessons 3 times a week) limits the adaptation capabilities of the body due to a decrease in the functional state of the sympathetic department of the autonomic nervous system.

Introduction. The issue of revealing disorders of the cardiovascular system during adaptation to learning and physical loads is one of the main ones in evaluation of the level of health of coming generation. Autonomic nervous system (ANS) plays a key role in implementation of urgent and long-term adaptation of organism to environmental factors, and this is the reason why indicators of the state of regulatory mechanisms could serve as informative criteria of the evaluation of the level of health [3-5].

Puberty is characterized as the neurohumoral alteration, stress of adaptation mechanisms, which make an organism sensitive to the effect of environmental factors [6]. It is adolescence, during which the increase in disorders of the autonomic nervous system is registered. According to data given by experts, vegetative dysfunctions are registered in 70-85% of adolescent schoolchildren [5]. Numerous studies show that physical loads have a beneficial effect on organism of children and adolescents, contributing to morphological and functional maturity of departments of the autonomic nervous system and health improvement in whole [4]. However, the absence of medical control, forcing loads and irrational combination of work and rest periods could have a negative effect on health of young athletes. According to E.A. Gavrilova, disorders in the autonomic nervous system were revealed in 6-35% of young athletes [2].

Therefore, it is important to understand in which cases sports activities could contribute to the health improvement and in which cases they could limit the development of the autonomic nervous system.

The purpose of this study is to evaluate functional state of the autonomic nervous system in children aged 11-16 years, who do and do not do sports.

Methods and organization. Young hockey players (n=100) and children, who do not do sports (n=104) aged 11-16 years participated in the study. Children, who do not do sports, had a usual mode of motor activity: physical culture classes 3 times a week as a part of school curriculum. Young athletes had an additional mode of motor activity: training 5 times a week. 3 age-related groups were formed among subjects: 11-12 years, 13-14 years and 15-16 years.

In order to evaluate the functional state of the autonomic nervous system an active orthostatic test (AOT) was used, by results of which the vegetative reactivity of the sympathetic department was evaluated according to the method developed by M.M. Belyaeva (2003). Indicators of the spectral analysis were used for the evaluation of the vegetative support of the cardiovascular system and the analysis of the functional state of segmental and suprasegmental departments of the VNS.

Processing of indicators obtained in the study was made using the Statistica 6.0. program. Checking by the Kolmogorov-Smirnov criterion showed a normal distribution of all examined values, which is why the Student's criterion was used for comparison of indicators. The significance of differences was considered as important if $p \leq 0,05$.

Results and discussion. Autonomic nervous system is a set of central and peripheral structures, which contribute to adaptation responses of organism when exposed to environmental factors. The sympathetic department contributes to the mobilization of energy resources and engagement of main physiological systems of an organism, which participate in urgent adaptation processes. The parasympathetic department provides sparing expenditure and recovery of energy resources, performing a trophotropic function [3]. Balanced work of ANS departments allows organism to maximize the use of physiological reserves and quickly restore spent resources.

During age development, the formation of ANS departments is subject to the principle of heterochronism. According to experts, the parasympathetic department almost finishes its development by the age of 7, while the sympathetic department continues to form until the age of 15-16, holds its activity until the age of 20-30 and then gradually decreases it [7].

Adolescence is the most difficult stage of the ontogenetic development of a human. Impact of physical and learning loads could have a negative effect on the

formation of regulatory mechanisms and provoke a development of maladaptation states.

Study results showed that 11-12 years old children did not have statistically significant differences in indicators of the spectral analysis of the heart rhythm variability at rest.

According to experts' opinion, a normal reaction to the orthostatic effect is characterized by a decrease of total capacity of a spectrum, an increase in LF-waves activity due to an activation of sympathetic department of the VN, a decrease in HF-waves activity. Debatable opinions on dynamics of VLF-waves during the orthostatic testing are related to an absence of information about their nature. Most of researchers connect the VLF-waves activity to the work of suprasegmental parts of the ANS [3].

During active orthostatic testing of 11-12 years old children, who do sports, a decrease in the HF-waves activity, indicating the vagus nerve tone, was registered. There were no differences in dynamics of LF-waves and VLF waves between children, who do and do not do sports (Fig. 1).

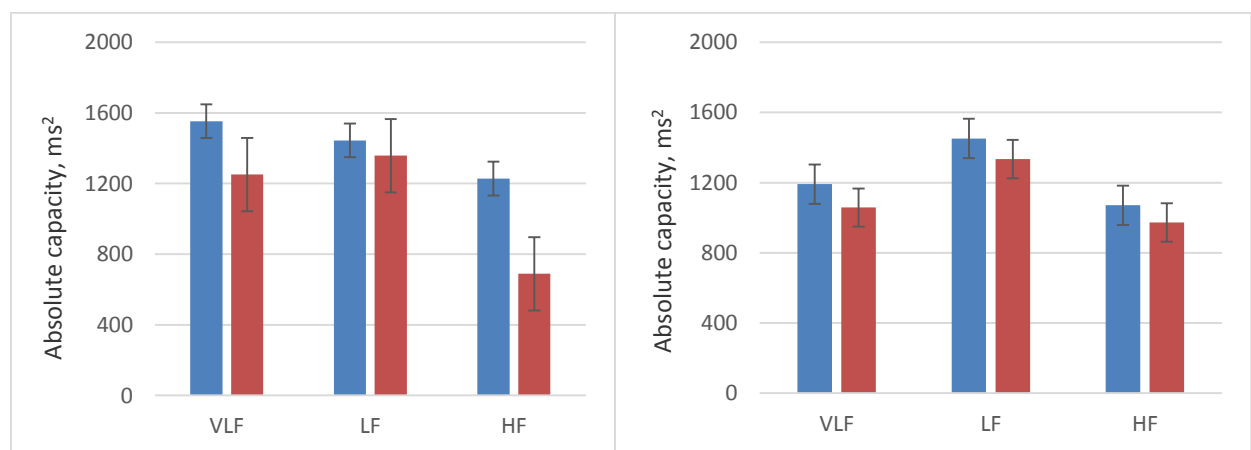


Fig. 1. Indicators of the spectral analysis at rest and during active orthostatic testing in athletes (A) and non-athletes (B) aged 11-12 years

Note: ■ - at rest, ■ - AOT

Reaction of the parasympathetic department of the ANS has similar dynamics in 13-14 years old children, who do and do not do sports. The response of the sympathetic department of the VNS is absent in athletes, which indicates an insufficient functional maturity of adrenergic mechanisms of regulation of cardiac activity in this age. There is growth in LF-waves activity and an increase in VLF-waves responsible for an activation of suprasegmental vegetative centers in children with normal motor activity (non-athletes), which indicates an inability of the sympathetic department to provide independently urgent adaptation of the

cardiovascular system and the need to solve tasks and during involvement of higher centers and leads to stress of regulatory mechanisms (Fig. 2).

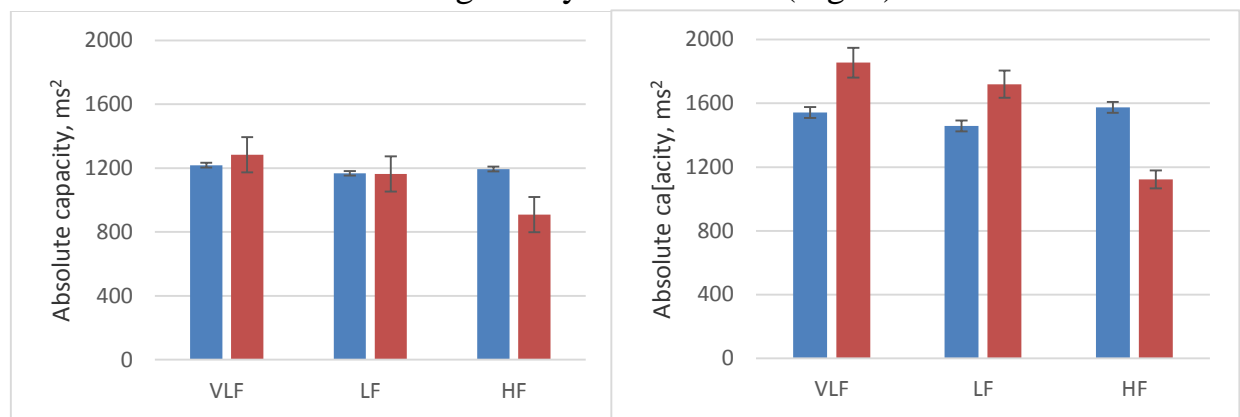


Fig. 1. Indicators of the spectral analysis at rest and during active orthostatic testing in athletes (A) and non-athletes (B) aged 13-14 years

Note: ■ - at rest, ■ - AOT

At the age of 15-16 years, one-directed changes in activity of segmental and suprasegmental parts of the ANS were observed in children, who do and do not do sports, although an inclusion of adrenergic mechanisms in athletes is more profound (Fig. 3)

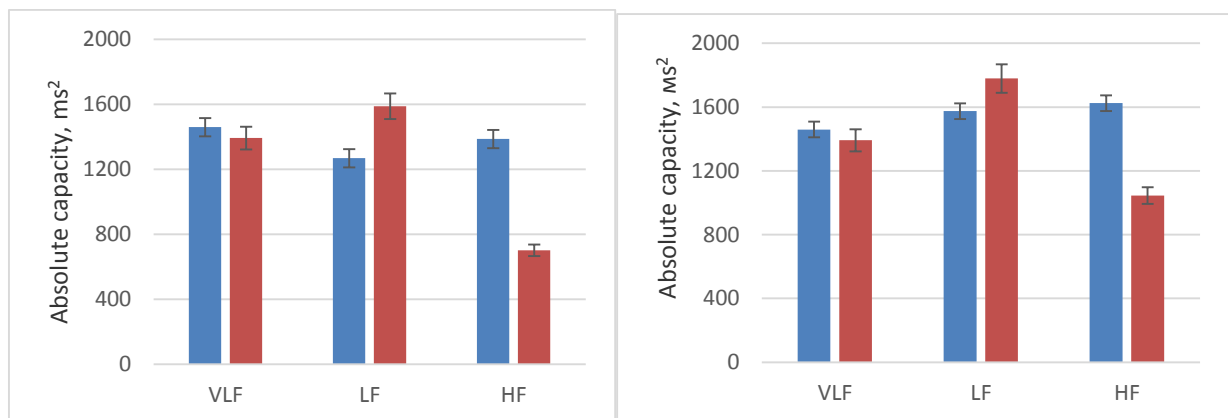


Fig. 3. Indicators of the spectral analysis at rest and during active orthostatic testing in athletes (A) and non-athletes (B) aged 15-16 years

Note: ■ - at rest, ■ - AOT

The evaluation of vegetative reactivity of the sympathetic department was conducted in relation of SI_1 (stress index, AOT) to SI_2 (stress index, background recording) according to the method developed by L.M. Belyaeva and E.K. Khrustalyova [1]. Study results showed that normal sympathicotonic type of vegetative reactivity was prevalent in 11-12 years old children, while in the group of those, who do not do sports, a bigger amount of children with the asympathicotonic (insufficient) type of VR.

At the age of 13-14 years among athletes and children with usual mode of motor activity a number of excessive response of the sympathetic department of the VNS (hypersympathicotonic type of vegetative reactivity).

At the age of 15-16 years in adolescents, who do not do sports, an insufficient activation of adrenergic mechanisms of regulation (asympathicotonic type of vegetative reactivity) was registered in 37% of cases, which indicates a delay of the functional maturity of the sympathetic department of the ANS (Fig. 4).

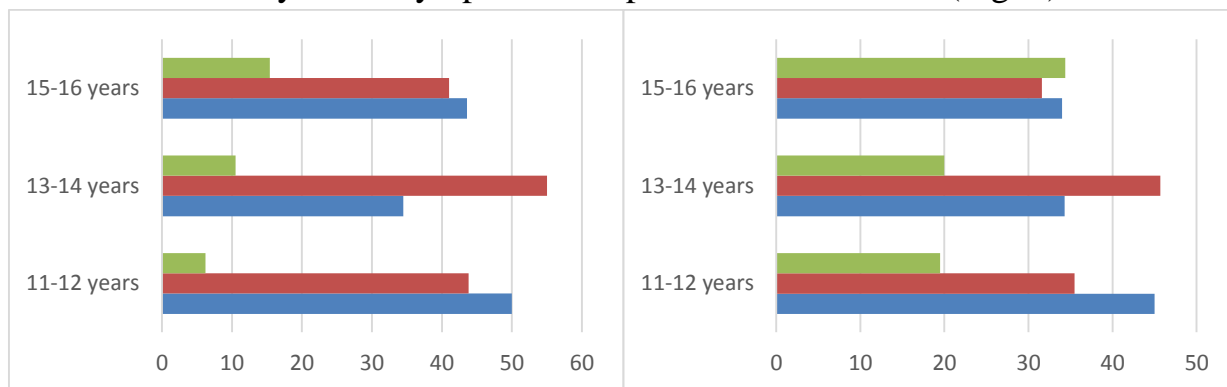


Fig. 4. Ratio of vegetative reactivity types in children (%), athletes (A) and non-athletes (B)

Note:
■ - sympatheticotonic (normal) type of VR
■ - hypersympathicotonic (excessive) type of VR
■ - asympathicotonic (insufficient) type of VR

Conclusion. Obtained data indicate a positive effect of additional physical loads on the organism of adolescents. In particular, hockey training classes contribute to an increase in the functional readiness of the sympathetic section of the ANS, speeding up its maturation. By the age of 15-16, the response to environmental impact from departments of the autonomic nervous system is close to the type of reaction typical for an adult organism. Children of that age with usual mode of motor activity (who do not do sports) have a delay in the development of adrenergic mechanisms of regulation, an increase in frequency of the manifestation of the asympathicotonic type of response to environmental impact.

It is also important to note that the functional state of the parasympathetic department of the ANS does not have differences between adolescents, who do and do not do sports, which confirms the fact that morphological and functional maturation of the parasympathetic department of the ANS is completed at the age of 7 years, that is, before puberty.

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