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RESTORATION OF ADAPTIVE RESOURCES OF THE BODY OF SPORTS UNIVERSITY STUDENTS DURING THE HOLIDAYS ACCORDING TO THE HEART RHYTHM SPECTRAL ANALYSIS

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Annotation. The article presents the dynamics of the heart rhythm spectral analysis indices of sports university students, which makes it possible to assess the restoration of the body's adaptive resources after the holidays. An increase in parasympathetic influence on the heart rhythm was revealed by an increase in high-frequency waves (HF, %), a decrease in sympathetic influence by a decrease in low-frequency (LF, %) waves, a decrease in very-low-frequency (VLF, %) waves indicated a reduction in humoral and metabolic influence and a decrease in the stress hormones' level. The presence of ultra-low waves (ULF, %) shows incomplete formation of adaptive mechanisms in the higher centers of heart rate regulation, which is associated with ontogenetic development and academic loads in a sports university. After the holidays, we registered a decrease in the stress index, the functional status index and the psychophysiological cost, reflecting the positive impact of proper rest during the holidays on the restoration of adaptive resources of the students' body, expanding the adaptive potential for various increasing loads.

Keywords: sports university students, adaptive resources of the body, holidays, heart rate variability, spectral analysis.

Introduction. Studying in a sports university, aside from academic and high physical loads, is associated with a need to fulfill a number of domestic, socio-economic, psychological, communicational and other needs. In order to fulfill these needs, significant resources are required, often at the cost of reduced rest and recuperation time. In addition, the body of students suffers various loads with significant stress on adaptive resources [1], mechanisms of which, due to ontogenetic development and influence of external factors, are still forming and not complete, which may have a negative impact on health of sport university students. Heart rhythm is the most reliable reflection of such abnormalities. A study on heart rate variability (HRV) has an important predictive and diagnostic value in case of various pathologies, psychoemotional (stress) and physical fatigue [2-3]. Dynamic observation over the heart rate variability indices during different periods of a human's life allows to estimate the level and degree of recovery of adaptive resources of the body,

which is important for the body of students of sports universities during the holidays, making it possible to expand the adaptive potential for the subsequent increasing loads of different nature during the study period.

Objective of the study: to estimate recovery of adaptive resources of the body of sports university students during holidays according to the heart rhythm spectral analysis.

Methods and organization. The study took place in the Russian University of Sports "GTSOLIFK", Moscow. It involved 2-year bachelor male and female students (n=16), who study in the specialty "Physical culture for people with disabilities (adaptive physical culture)" (code: 49.03.02), profile – "Physical rehabilitation", and attend campus classes. Age of the participants – 20 years. Aside from theoretical classes, according to the curriculum, the students had increased physical loads that were implemented at least 3-4 times a week in practical classes on the following subjects: "Methods of teaching in team sports", "Technologies of physical culture and sports

activities”, “Classical massage”, “Physical rehabilitation in pulmonology”, “Theory and methodology of physical culture”, “Theory and organization of adaptive physical culture”. This study consisted of two stages: 1st stage – June 2023 (pre-exams period), 2nd stage – September 2023 (after summer holidays). The HRV indices were investigated in order to identify the functional and psycho-emotional status of sports university students after the holidays.

HRV was estimated with the BioMouse complex (Neurolab, Russia) using the standard method [4]. Following HRV indices were registered: fast or high-frequency waves (HF, %) with oscillation frequency of 0.40-0.15 Hz, reflecting activity of the parasympathetic nervous system; low-frequency waves (LF, %) with a frequency of 0.15-0.04 Hz, caused by fluctuations in the sympathetic nervous system activity; very-low-frequency waves (VLF, %) with a frequency of 0.04-0.0033 Hz, caused by an activity of humoral and metabolic system

(renin-angiotensin system, pituitary and thyroid hormones, electrolyte content, etc.); presence of ultra-low-frequency waves (ULF, %), which reflect the involvement and level of activity of higher (cortical) centers in the regulation of heart rhythm. We also considered heart rate (HR, beats/min), stress index (SI, c.u.), studied values of the indices that were automatically calculated by the program: psychophysiological cost (PC, c.u.), functional status index (PSI, c.u.).

The statistical processing of results was done with Statistica 13: we calculated mean arithmetic values and standard deviation of the received indices, the significance of changes was identified with the Wilcoxon’s signed rank test ($p < 0.05$).

Results and discussion. Changes in the indices reflecting recovery of adaptive resources of the sports university students during the holidays is shown in table below.

Table

Changes in heart rate variability of the sports university students before and after the holidays, $\bar{X} \pm \sigma$

Indices	Stages of the study	
	1 st stage (June)	2 nd stage (September)
HR mean, beats/min	75,6±6,08	77,66±7,44
HR (standard), beats/min	73±9,75	73,00±9,75
SI, c.u.	90,42±8,49	59,52±3,62*
PC, c.u.	876,74±92,73	731,94±61,95*
FSI, c.u.	79,64±10,28	22,66±3,11*
HF, %	34,56±10,67	46,72±11,38*
LF, %	43,30±9,95	37,00±9,15*
VLF, %	19,84±11,97	15,66±6,12*
ULF, %	2,32±0,19	0,62±0,04*

Note: HR – heart rate; SI – stress index; PC – psychophysiological cost; FSI – functional status index; HF – high-frequency waves; LF – low-frequency waves; VLF – very-low-frequency waves; ULF – ultra-low-frequency waves; * – significance level of changes in the index’s values, $p < 0.05$

Heart rate (HR, beats/min) that reflect a total effect of heart rhythm regulation, was normal at all stages of the study (75.6±16.08 and 77.66±7.44 beats/min). Stress index (SI, c.u) that characterizes a state of stress in the central regulation curve, significantly reduced at the second stage after the holidays ($p < 0.05$) from 90.42±8.49 to 59.52±3.62 c.u., reflecting lower sympathetic effect on heart rate, lower stress,

showing full recovery of the studied group during the holidays (table).

The functional status index (FSI) reflecting the state of regulatory mechanisms reduced from 79.64±10.28 to 22.66±3.11 c.u., showing reduced stress on the heart rhythm regulation mechanisms, proven by decreased values of the psychophysiological cost from 876.74±92.73 to 731.94±61.95 c.u., which in total demonstrates

recovery of the body's resources. HF increased from 34.56 ± 10.67 to $46.72 \pm 11.38\%$, reflecting an activation of parasympathetic cardioinhibitory center of medulla oblongata, significant reduction of stress level. LF reduction from 43.30 ± 9.95 to $37.00 \pm 9.15\%$ shows a decrease in an activity of sympathetic centers of medulla oblongata, reduced stress and recovery of adaptive capabilities in the studied group. Reduction of VLF from 19.84 ± 11.97 to $15.66 \pm 6.12\%$ shows a decreased activity of central ergotropic, humoral and metabolic heart rhythm regulation mechanisms. ULF waves also decrease from 2.32 ± 0.19 to $0.62 \pm 0.04\%$, showing a reduced activity of higher centers in heart rhythm regulation. Moreover, a presence of ultra-low waves in the structure of heart rhythm regulation reflects incomplete processes of forming adaptive mechanisms associates with ontogenic development [5], as well as academic loads on the bodies of the students. The aforementioned confirms relevance of the study on recovery processes of adaptive resources of the

sports university students during the holidays according to the heart rhythm spectral analysis.

Conclusion Recovery of adaptive resources was shown in reduced stress on the function of the cardiovascular system according to the spectral analysis, recovery of psychophysiological state (according to reduced values of the functional status index and psychophysiological cost). The aforementioned shows the need in proper rest during the holidays for students, especially those during first years of study, since they have incomplete formation of adaptive mechanisms associated with ontogenic development, which, combined with academic loads, may cause a negative effect on the body and health of student youth. Full rest during the holidays and reduced risk of stressful situations have a positive effect on the function of the cardiovascular system, increases adaptive recourses, allowing regulatory systems of the body to return to optimal functioning level, which expands adaptive reserves of the body of students to subsequent increasing loads of different nature.

Conflict of interest. The authors declare no conflict of interest.

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