The use of stochastic and deterministic loads in students

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Introduction. Determination of physical performance occupies an important place, both in sports and in assessing the status of people of different age and sex, engaged in physical culture. Diagnostic systems and organs of the body relates to the basic problem of modern sports medicine, methods which are constantly updated and improved. Objective assessment of physical health is important for achieving high results in the modern sports. The most popular are the constants, step, step-increasing workloads, which can be attributed to the type of deterministic. However, there is inadequacy of determination between the complexity of regulation of the cardiovascular system and the complexity of the test signal. Eliminates this contradiction is the use of stochastic test signals, power value of which changes at random

For research and practical diagnostic purposes is interesting to compare the reaction of the cardiovascular system in deterministic and random loads. This was the subject of the present study.

Material and methods. In the present study two types of stress research were used: the traditional test with stepwise increasing load (50, 100, 150 W) and duration of each stage for 3 minutes and test with a stochastic pseudonormal law distribution in the range 40 - 160 W and duration of each stage 30 seconds. Both samples were comparable in terms of work done, the average power of 100 W and the duration of the study 9 minutes. Programmable cycle ergometer was used to conduct ECG monitoring. Assessment of autonomic status was conducted before and after the surrogate and the random test. In the study group included 72 students involved in sports (playing sports) (mean age 20.3 years), who were asked to perform two types of loads with a break to rest between research 1.5 - 2 hours. In reality, the load was carried out to obtain the submaximal heart rate. Submaximal heart rate corresponds to the following (200 - age of the subject). Variation parameters were in variation range (MxdMn), standard deviation (SDNN) and the stress - index (Si).

Results. The average power load required to achieve a submaximal heart rate was 509 W for the step-increasing and 445 W for the stochastic test, respectively. At the same time achieving submaximal heart rate at stepwise-increasing load was 7 min., while the stochastic load significantly earlier – 5 minute 3 second ($p < 0.05$). In the study group individuals the response of heart rate variability in physical activity was expressed in the form of lower amplitude variations of rhythm MxdMn to 15.8% in the standard and 19.4 % for the stochastic load ($p < 0.05$), reduced SDNN standard deviation of 17.8 %

and 23.1 %, respectively ($p < 0,05$). In this case, an increase in stress-index Si at 68.6 % with a standard and by 49.7 % in the stochastic load ($p < 0.05$).

Discussion. The results obtained allow concluding that the random load limit of efficiency of the cardiovascular system is achieved faster than deterministic. This may be due to several reasons. First, the random loads are adequate frequency properties of the system of regulation of cardiac rhythm, which in turn is a lot of complex hierarchical system, which combines the autonomous and central mechanisms of regulation. When using a stochastic load of more active mechanisms of vagal and sympathetic regulation. Secondly, the element of chance and inadvertently additionally activates the central nervous system. At the same time as a result of the need to centralization of the attention activates the central nervous system. Third, we are dealing with different levels of power swings. Information utility of stochastic test is 62 % higher than the deterministic.

Comparing algorithms for the implementation of deterministic and stochastic loads, it can be assumed that the increased information load requires more intensive work of all control loops. The difference between them shows the reserves of the regulation of blood circulation. In our case we are talking about the regulation of heart rate and coronary circulation.

Thus, the random sequence of power due to the unpredictability and adequacy frequency response of the organism makes it possible to roughly 1.5 times faster and more accurately establish the physiological reserves of the organism.

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In the study the comparison of original and dynamic heart rate variability after a stochastic, and deterministic loads was done. Study group included 72 students involved in sports (playing sports) (mean age 20.3 years), who were asked to perform two types of loads with a break to rest between research 1.5 - 2 hours. The reaction of cardio-vascular system on the deterministic and random loads was evaluated. At the same time achieving submaximal heart rate at stepwise-increasing load was 7 min., while the stochastic load significantly earlier – 5 min. The results obtained allow concluding that the stochastic load limit of efficiency of the cardiovascular system is achieved faster than deterministic. Stress test using random loads may contribute to the training effect in athletes.