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Heart Rate Variability and its Determination in Students by the Express Method

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Abstract: The purpose of the study is to assess the functional state of students of one age group (18-20 years old, n=135) for 2 years (2023, 2024, 1st and 2nd year, respectively) during an active educational process based on the analysis of heart rate variability parameters. Students underwent an electrocardiographic (ECG) examination using the Varicard 2.52 software and hardware complex. Research has shown that 40.5% of girls out of 97 surveyed and 35.6% of boys out of 38 people have a state of tension in their regulatory systems.

Keywords: physical activity, students, adaptation, heart rate variability, stress index, varicardium.

Introduction. The functional state (FS) of students is supported by a number of body regulation systems. It is known that the cardiovascular system (CVS) is the most sensitive to changes in the physical activity of the whole organism [1]. The rhythm and strength of heart contractions quickly respond to environmental changes and are used to characterize the level of adaptation and stress [2]. One of the methods for assessing the state of the autonomic nervous system (ANS) is the analysis of heart rate variability (HRV) [3]. HRV is a non-invasive method for diagnosing the body's physical activity, based on the measurement and analysis of ECG time R-R intervals. Cardiac rhythm contains information about processes occurring not only within the cardiovascular system [4], but also in nerve centers and the endocrine system. Changes in HRV indicators in students under the influence of academic load are described in a number of works [5]. According to the scientific literature, the features of the adaptation process are also determined by the type of autonomic regulation of heart rhythm. Therefore, it remains relevant to analyze the adaptive capabilities of young people to identify the likelihood of developing functional disorders. It is worth noting that the authors of the following articles synthesized substances with broad biological activity, including for CVS [6-10]. Student youth constitute a special social group of the population. A large flow of information, overloaded work programs, combined with an incorrect schedule, create a tendency for these factors to have a negative impact on the health of students [11]. In addition, recently there has been a clear tendency towards a decrease in the level of physical activity of students. Therefore, the number of students with health problems is naturally increasing, and the number of preparatory and special medical groups is increasing [12]. According to scientific and methodological literature, in some universities in the country the number of students with health problems has increased to 30%. Therefore, students' adaptation to physical activity becomes an urgent problem that requires solutions throughout their studies at an educational institution. One of the available, fairly effective methods for studying the adaptive capabilities of the body is heart rate variability (HRV) according to R. M. Baevsky. The purpose of this study was to study the adaptive capabilities of the body of university students under the influence of physical education classes.

Research methods and principles. During 2023 – 2024 Students (n=135, 97 girls and 38 boys, 18-20 years old) of Alfraganus University in Tashkent, Republic of Uzbekistan were examined to assess adaptive capabilities in terms of heart rate variability. Students were examined in the fall semester and spring semester during an active educational process without functional loads on a voluntary basis. The students' somatometric (height, weight) and physiometric parameters (blood pressure, pulse) were measured. A survey was conducted to assess their lifestyle. Body mass index was calculated. Express assessment of the level of physical condition was carried out according to the method of E.A. Pirogova, which allows, without functional tests, to assess the individual level of health based on data on age, heart rate, weight, height, and blood pressure. To analyze the adaptive state of students, an ECG was recorded using the "Varicard 2.52" software and hardware complex (5 min.).

Main results. Based on research conducted over several years at the Department of Pharmacy and Chemistry of Alfraganus University, we come to the conclusion that the assessment of a student's physical condition should begin with a rapid assessment of his adaptive mechanisms. Using the "Varicard" software and hardware complex allows you to receive, within 5 minutes, information printed on a sheet of paper about the voltage level of regulatory systems and the functional state of the body corresponding to this level. At the time of the study there should be no interference leading to emotional arousal; it is necessary to exclude conversations with the subject, telephone calls and the appearance of other persons in the laboratory. When recording HRV, it is necessary to ensure that the subject does not take deep breaths, cough, or swallow saliva. In adolescent girls, HRV studies during the menstrual period are excluded, since during this period the hormonal changes that occur in the body affect the state of the regulatory systems. Before the start of the study, it is necessary to conduct a survey of the subjects about the loads performed on the previous training day or at the first training session, about their well-being, daily routine, quality of sleep, and nutrition. Processing of cardiointervalograms and analysis of heart rate variability were carried out using the Varicard 2.52 device and the ISCIM-6 and Varicard-MP programs. The device is connected to the computer. The Varicard-MP program allows you to record HRV indicators in one or several students at the same time (up to 12), which allows the researcher to have complete information about the functional readiness, reserve capabilities of the body, the level of recovery immediately before classes for the whole group and make timely adjustments to the educational process every student.

So, in 2023-2024. 135 students were examined using the Varicard 2.52 complex (Table 1). Research has shown that 40.5% of girls out of 97 surveyed and 35.6% of boys out of 38 people have a state of tension in regulatory systems, i.e. In these students, the optimal capabilities of the body are ensured by a higher than normal expenditure of functional reserves.

Table 1. Indicator of regulatory activity among Alfraganus students (%)

IRAS	Girls (n=787)	Boys (n=278)
Physiological norm (1-3)	38,4	33,5
Prenosological conditions (4-5)	40,5	35,6
Premorbid conditions (6-7)	18,9	26,8
Failure of adaptation (8-10)	2,2	4,1

A decrease in the functional capabilities of the body, reflecting a state of overexertion and pre-illness, was detected in 18.9% of girls and 26.8% of boys, and failure of adaptation (illness) was found in 2.2% of girls and 4.1% of boys.

Conclusion. The data we obtained convincingly show that the Varicard software and hardware complex allows for a rapid assessment of a person's adaptive mechanisms and makes a preliminary conclusion about his physical condition.

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