

THE ROLE OF MUSIC IN THE CORRECTION OF THE FUNCTIONAL
STATE OF STUDENTS

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With the method of variational pulsometry by R.M.Baevsky, the influence of classical music on the integral and spectral characteristics of the activity of the regulatory mechanisms of the heart rhythm of students, observed during a one-day study load, was studied by the method of computer registration and analysis of the ECG. ECG registration and analysis were carried out on students of YSU in three experimental situations: before the first lesson (physiological norm); after the end of the 6th lesson; after listening to classical music for 20 minutes. Two types of response of the functional indicators of students to the study load were revealed: sympathetic and parasympathetic. It has been established that after a study load, a session of music therapy contributes to a return of the levels of all studied heart rate indicators towards the physiological norm (initial values before the class).

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Introduction. The development of nations and the well-being of population is largely determined by the state of the country's education system. This determines the fact that at present one of the urgent problems of physiology and hygiene is the provision of conditions conducive to strengthening the health of the population, especially those employed in the field of mental labor – students, teachers, scientists, scholars, etc. The process of learning at a university is accompanied by intense mental activity, processing and memorization of large amounts of information, which requires memory strain and concentration. An irrationally organized learning process can cause students to form many different types of stress, including “stress of limited time”. The stress state is also caused by physical inactivity, violation of regimes of work, rest, nutrition, which contributes to a weakening of the immune system, overwork, the occurrence of chronic fatigue syndrome, which, ultimately, can cause the formation of pathological processes in the body. In modern literary sources, numerous data are presented that highlight the functional changes that occur in certain body systems during a high-intensity training load and psycho-emotional stress [1–3]. In this regard, there is a need to use optimal, non-drug methods for correcting functional shifts formed in students under the influence of psychophysiological stress [4–5].

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At present, as non-traditional means of preventing fatigue and nervous tension, the formation of mental and intellectual abilities, increasing efficiency, optimizing the work of the cardiovascular and other body systems, aroma-, color-, music therapy, physical culture and sports are being popularized [6–7]. The influence of music on the body was studied by the outstanding psychotherapist V.M. Bekhterev [8]. Currently, music therapy is officially recognized in many countries of Europe and Asia. It has been established that the emotional arousal that occurs when listening to properly selected music enhances attention, activates the central nervous system, increases the performance of verbal and non-verbal intelligence, stimulates muscle activity, and reduces the load on the working parts of the human body. The intensive development of music therapy in order to solve the main problems of restorative medicine suggests the expediency of using music to activate reserve capabilities and general health improvement of students during their studies. At the same time, it was found that when listening to classical music and hard rock, multidirectional shifts in human functional indicators are observed. When listening to rock music, there is an increase in the active-aggressive components of the emotional state, and classical music – a decrease in aggressiveness, an increase in a sense of psychological well-being [7]. At the same time, classical music is capable of exerting a sufficiently long and universal impact, devoid of the saturation effect [6, 8, 9].

Based on this, in this series of experiments, we studied the effect of calm classical music, as a means of non-drug correction of the functional state of a person, on the activity of the regulatory mechanisms of the heart rhythm of students during an educational load.

Materials and Methods. In the experiments, 20 absolutely healthy students of the Faculty of Biology of Yerevan State University participated on a voluntary basis. To analyze the indicators of the activity of the regulatory mechanisms of the heart rhythm on a personal computer, an ECG was recorded in the first standard lead in the sitting position. Registration and analysis of the ECG was carried out in 3 experimental situations: before the start of the lessons; after the end of classes; after listening to calm classical music for the purpose of relaxation (20 minutes). Analysis of each of the 5-minute ECG samples in all experimental situations was carried out by R.M. Baevsky's method of variational pulsometry using a computer program developed within the framework of the LabView software package at the Institute of Physiology named after L.A. Orbeli of the NAS of the Republic of Armenia.

The effect of a music therapy session on the functional state of students was studied after classes on Wednesday, when, according to the literature data, the most pronounced reaction of the functional systems of the students' body to the training load is observed. The selection of music was carried out taking into account the following requirements: the subjects should like the music, be familiar and pleasant. A survey of the subjects showed that they prefer melodic music to rhythmic music. In this regard, fragments from Mozart's Concerto for Piano and Orchestra with an intensity of 61 dB were used as a relaxation load.

The following temporal and frequency indicators of heart rate were calculated: heart rate (HR); mode (Mo, sec) – the most frequently occurring value of cardio intervals; amplitude of the mode (AMo, %) – frequency of occurrence of the mode;

variation scope (ΔX , sec) – the degree of variability of cardio intervals values; coefficient of variation of cardio intervals (CV); Baevsky's stress index (SI) – tension index of the regulatory systems of the heart; vegetative rhythm index (VRI); vegetative balance index (VBI); indicator of adequacy for regulatory processes (IARP, = AM_o / Mo).

The reliability of the obtained results was confirmed by the computer program "Biostat" by statistical analysis using Student's t test.

Results. The analysis of the data obtained showed that the student subjects differ in the type of response of the characteristics of the heart rhythm to the training load. In 54.6% of the studied girls (I group) on Wednesday at the end of the school day, an increase in the level of markers of the sympathetic circuit of heart rhythm regulation - HR and SI (sympathetic type of reaction to the study load) was observed. The rest of the subjects (45.4%) were characterized by a parasympathetic type of response to the training load, which manifested itself in a decrease in the values of HR and SI and an increase in the activity of markers of the parasympathetic regulation circuit (II group).

Table

Changes in the indicators of the heart rhythm of students in the dynamics of the impact of the study load and classical music

Indicator	I group			II group		
	Before class	After class	After exposure to music	Before class	After class	After exposure to music
SI (a.u.)	54.5±9.16	85.41±17.36 p<0.05	62.18±11.17 p<0.01	123.8±29.14	65.64±13.64 p<0.02	81.38±17.03 p<0.02
HR (bpm)	83.17±3.8	81.0±3.77	78.17±2.65	83.5±2.56	76.0±2.09 p<0.001	82.12±1.63 p<0.001
Mo (sec)	0.76±0.02	0.73±0.06	0.76±0.04	0.70±0.02	0.73±0.03	0.74±0.03
ΔX (sec)	0.57±0.11	0.35±0.04 p<0.01	0.46±0.03	0.37±0.08	0.46±0.09	0.43±0.08
AMo (%)	35.5±3.81	40.53±3.59 p<0.001	30.5±2.41 p<0.02	47.5±4.85	33.36±2.32 p<0.001	40.0±2.35 p<0.01
VBI (a.u.)	73.25±12.94	117.1±20.75 p<0.02	89.9±14.11 p<0.001	168.0±36.94	96.72±17.75 p<0.01	119.7±23.84 p<0.02
IARP (a.u.)	53.04±5.99	56.78±6.75	41.51±3.98 p<0.001	69.27±8.14	46.50±3.26 p<0.001	54.72±4.65 p<0.01
VRI (a.u.)	3.08±0.48	4.48±0.62 p<0.05	3.60±0.58 p<0.01	4.82±0.75	3.67±0.53 p<0.05	4.15±0.7
CV	13.36±1.78	9.61±1.51 p<0.05	10.05±1.52	8.12±1.33	11.93±2.69 p<0.05	9.17±1.55 p<0.05

As can be seen from the table, the subjects of group I on Wednesday at the end of the school day showed a significant increase in SI by 56.7% ($p<0.001$), compared with morning indicators, due to a decrease in the activity of the parasympathetic and humoral circuits of heart rate regulation (ΔX and Mo) by 39.6% ($p<0.01$) and 4.0%, respectively. This is also evidenced by the decrease in the coefficient of variation of R–R intervals by 39.6% ($p<0.01$) observed in the dynamics of the school day. The change in heart rate was not pronounced. The

observed shifts were also accompanied by an increase in the activity of the markers of the sympathetic nervous system studied by us – AMo, VRI, IARP, VBI by 14.2% ($p < 0.001$); 45.5% ($p < 0.05$); 7.05%; 59.9% ($p < 0.02$), respectively. The changes observed in the dynamics of the one-day study load in the subjects of I group indicate a tension in the regulatory mechanisms of the heart rhythm, a shift in the autonomic balance towards a pronounced predominance of the activity of the sympathetic division of the ANS, which is a reflection of the increasing centralization of heart rate control, and the strengthening of the modulating effect of the hypothalamus.

Mathematical analysis of changes in the integral indicators of the heart rate of the subjects of the second group revealed a decrease in SI by 53.02% ($p < 0.02$) by the end of the school day, due to a decrease in AMO by 29.7% ($p < 0.001$) and an increase in levels Mo and ΔX by 4.2% and 24.3% ($p < 0.05$), respectively. The values of VRI, IARP, VBI at the same time decreased by 23.9% ($p < 0.05$); 42.5% ($p < 0.01$); 32.9% ($p < 0.001$), respectively.

Changes that occur under the influence of a one-day training load in the subjects of II group (reduction of SI, a high degree of variability of R–R intervals, an increase in Mo and ΔX) indicate decentralization of the processes of heart rhythm regulation and the predominance of the parasympathetic tone of the ANS within the autonomous circuit of heart rhythm regulation due to developing fatigue in the dynamics of the school day.

After a simultaneous session of music therapy in both groups of subjects, there was a shift in the levels of all studied heart rate indicators towards a return to the original values. At the same time, the most pronounced effect of calm music was observed on the physiological parameters of female students with a sympathetic type of response to the study load. In the group with a parasympathetic type of response of the functional systems of the body to the training load, after a session of music therapy, there was a tendency to increase the levels of markers of the sympathetic nervous system (SI, AMo, VRI, IARP, VBI, HR), which, however, still remained below the initial values.

It is known that the mechanisms of change in time and frequency indicators of heart rate are mainly due to the nature of the initial imbalance of vegetative effects on the heart. With an initially balanced sympathetic-parasympathetic effect on the heart rate, but a high centralization of its control, after exposure to the relax factor, its decrease is noted, and the overall and respiratory rhythm variability increases. With sympathicotonia, there is a simultaneous decrease in the initially increased centralization of the heart rhythm and a pronounced predominance of sympathetic influences with a parallel increase in the modulating influence of parasympathetic mechanisms. However, with the initial predominance of parasympathetic activity, the same information flows enhance the sympathetic regulation of the chronotropic function of the heart.

The latter indicates that the observed shifts in the activity of the regulatory systems of the heart rhythm testify to the relaxing effect of calm music on the body. A number of authors also testify in favor of this assumption, according to which music is only a means of correcting the functional state of a person when it allows changing this state in the direction of the norm [3, 6, 9]. According to the literature devoted to the study of the relaxation effect of music on the physiological functions

of the body, since the normal human heart rate is mainly 68–72 beats per minute, and the rhythm of the works of Bach, Mozart, Vivaldi, etc. is 60 quarters per minute, then when listening to the classical music, the rhythm of the heart begins to adapt to the sounding rhythm [6]. N.A. Fudin and co-authors, studying the influence of music on the state of students before the exam and on the effectiveness of their performance of test activities, found that certain pieces of music improve well-being, reduce psycho-emotional stress, normalize autonomic tone and increase the efficiency of the subjects [9].

According to V.G. Zilov et al., when listening to calm music, it is likely that there is a general, characteristic of other non-drug methods of relaxation, a regulatory effect based on the mobilization of the body's internal compensatory mechanisms that ensure the maintenance of homeostasis [10]. In adolescents and young people, as a result of a course of music therapy, a number of authors revealed an increase in the integrative function of the brain, an increase in non-verbal intelligence, and an improvement in attention and memory [6, 9].

Conclusion. Thus, classical music has an effective rehabilitation effect on the vegetative status of students, regardless of the type of response of their functional indicators to the study load, and helps to prevent negative processes in the body, normalize vegetative tone and increase the efficiency of activities in the learning process. At the same time, the fundamental basis of the optimizing influence of music on the functions of the heart is the balance of autonomic mechanisms of heart rhythm regulation observed under the influence of classical music.

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ԵՐԱԺՇՏՈՒԹՅԱՆ ԴԵՐՐՆ ՈՒՍԱՆՈՂՆԵՐԻ ՖՈՒՆԿՑԻԱԿԱԼ ՎԻՃԱԿԻ ՈՒՂՂՄԱՆ ՄԵՁ

ԷՍԳ համակարգչային գրանցման և վերլուծության մեթոդով Ռ.Ս.Բանսկու վարիացիոն պոլսոմետրիա ծրագրով ուսումնասիրվել է դասական երաժշտության ազդեցությունը ուսանողների սրտի ռիթմի կարգավորող մեխանիզմների գործունեության ինտեգրալ և սպեկտրալ բնութագրերի վրա, դիտված մեկօրյա ուսումնական ծանրաբեռնվածության ընթացքում: Երևանի պետական համալսարանի ուսանողների ԷՍԳ-ի գրանցումը և վերլուծությունը իրականացվել են երեք փորձարարական իրավիճակներում. առաջին դասից առաջ (ֆիզիոլոգիական նորմ); 6-րդ դասի ավարտից հետո; 20 րոպե դասական երաժշտություն լսելուց հետո: Բացահայտվել է ուսումնական ծանրաբեռնվածությանը ուսանողների ֆունկցիոնալ ցուցանիշների արձագանքման երկու տեսակ՝ սիմպաթիկ և պարասիմպաթիկ: Հաստատվել է, որ ուսումնական ծանրաբեռնվածությունից հետո երաժշտական թերապիայի կիրառումը նպաստում է սրտի ռիթմի բոլոր ուսումնասիրված ցուցիչների մակարդակների վերադարձին դեպի ֆիզիոլոգիական նորմ (նախնական արժեքներին մինչև դասերի մեկնարկը):

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РОЛЬ МУЗЫКИ В КОРРЕКЦИИ ФУНКЦИОНАЛЬНОГО СОСТОЯНИЯ СТУДЕНТОВ

Методом компьютерной регистрации и анализа ЭКГ программой вариационной пульсометрии Р.М. Баевского исследовано влияние классической музыки на интегральные и спектральные характеристики активности регуляторных механизмов ритма сердца студентов, наблюдаемые при однодневной учебной нагрузке. Регистрация и анализ ЭКГ осуществлялись на студентах ЕГУ в трех экспериментальных ситуациях: перед первым уроком (физиологическая норма); после окончания 6 урока; после 20-минутного прослушивания классической музыки. Выявлено два характера реагирования функциональных показателей учащихся на учебную нагрузку: симпатический и парасимпатический. Установлено, что после учебной нагрузки сеанс музыкотерапии способствует возвращению уровней всех исследованных показателей сердечного ритма к физиологической норме (исходным значениям до начала занятий).