

PHYSIOLOGY

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_1  
UDC 665.334.7: [58.072+612.115.12]

**EFFECT OF BLACK CUMIN OIL ON DIFFERENT UNITS OF HEMOSTASIS IN RATS UNDER CONDITIONS OF ENDOGENOUS THROMBINEMIA**

**Kh.M. Alkhasova<sup>1,2</sup>, A.V. Zinov'eva<sup>3</sup>, T.Yu. Astakhova<sup>3</sup>, A.V. Nekhorosheva<sup>2</sup>, S.V. Nekhoroshev<sup>2</sup>, V.G. Solov'ev<sup>2</sup>**

<sup>1</sup>Occupational Pathology Center, Center for Laboratory Diagnostics, Khanty-Mansiysk, Russia

<sup>2</sup>Khanty-Mansiysk State Medical Academy, Khanty-Mansiysk, Russia

<sup>3</sup>Okrug Clinical Hospital, Khanty-Mansiysk, Russia

**Abstract.** Most natural biological processes occurring in the body are associated with the free radicals formation. The antioxidant activity of terpene and phenolic compounds is explained by the ability to absorb free radicals, give hydrogen atoms, electrons or chelate metal cations. The purpose of our research was to study the antioxidant potential of black cumin oil (BCO) and its effect on the blood coagulation properties in laboratory rats. The study included 60 male non-inbred white rats, divided into 5 groups, each of which included 12 rats: group 1 (intact), 2 control (without additional food supplements, but exposed to stress) and 2 experimental ones, which additionally received BCO in a dose of 1 ml for each rat daily for 28 days and were exposed to stress. Endogenous thrombinemia was reproduced using combined (hypothermia + physical exercise) stress. Blood samples were taken immediately and 60 minutes after the end of the stress test. Blood for coagulation studies was stabilized with a 3.8% sodium citrate solution in 1:9 ratio and with a 0.1% buffered glutaraldehyde solution (for studying platelet morphology). The coagulation hemostasis parameters (protrombin index, partial thromboplastin time, thrombin time, fibrinogen content, antithrombin III, D-dimer) were also identified. The total platelet count and assessment of the morphofunctional status of platelets were examined with direct microscopy in a Goryaev grid [6]. In addition, the antioxidant potential of BCO was identified by the malondialdehyde content. Additional introduction of the “Ethiopian black cumin oil” supplement weakened the endogenous induction of thrombinogenesis caused by combined stress exposure, which was accompanied by a reduction in the increase in the content of activated platelets, markers of the thrombin-fibrinogen interaction and the development of secondary hypocoagulemia.

**Keywords:** *Nigella sativa*, black cumin, black cumin oil, platelets, reactive oxygen species, oxidative stress, lipid peroxidation, hemostasis.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_2  
UDC 612.66; 612.17; 612.133

**COMPLEX STUDY OF AGE FEATURES OF CENTRAL, PERIPHERAL HEMODYNAMICS AND MICROCIRCULATION IN PEOPLE WITHOUT CARDIOVASCULAR DISEASES**

**I.V. Andreeva<sup>1</sup>, A.S. Grigor'ev<sup>2</sup>**

<sup>1</sup>Moscow Regional Research Institute named after M.F. Vladimirsky, Moscow, Russia

<sup>2</sup>Ryazan State Medical University named after Academician I.P. Pavlov, Ryazan, Russia

**Abstract.** The aim of the study was to examine the age-related correlations between the indices of central and peripheral hemodynamics, microcirculation and endothelial function in healthy people before and after physical activity. The study was conducted on 136 adult healthy patients divided into age groups. All the patients underwent ultrasound doppler velocimetry of the common carotid and vertebral arteries, the indices of hemodynamics were examined with

compression oscillometry, microcirculation – with laser doppler flowmetry. In people without cardiovascular diseases, vascular aging factors (an increase in the thickness of the intima-media complex, the rate of pulse wave propagation, total vascular resistance, increased blood pressure, decreased ejection fraction, cardiac index, cardiac volume, and others) are not significant. There is no statistically significant connection between the indices of central, peripheral hemodynamics and the microcirculation system in the age aspect.

**Keywords:** hemodynamics, oscillometry, ultrasound doppler velocimetry, laser doppler flowmetry, age-related changes.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_3

UDC 612.171.1"345"-047.44

### **HEART RATE VARIABILITY DURING SLEEP: POSSIBILITIES AND PROSPECTS (REVIEW)**

**D.A. Butsko<sup>1</sup>, A.Yu. Gorkavaya<sup>1</sup>, S.V. Knysh<sup>2</sup>, N.S. Chepurnova<sup>2</sup>**

<sup>1</sup>Far Eastern Federal University, Vladivostok, Russia

<sup>2</sup>Pacific State Medical University, Vladivostok, Russia

**Abstract.** The review explores the possibilities and prospects of analyzing night-time cardiointervalography recording. According to modern references, the most informative indices of heart rate variability during sleep were RMSSD (root mean square of successive differences), pNN50 (*proportion of consecutive beat-to-beat intervals that differ by more than 50 ms*), LF- (low-frequency), HF- (high-frequency) and VLF-oscillations (very-low-frequency), LF/HF and SI (stress index). Areas of relevance are the directions of surveying circadian rhythms of the heart during phases and stages of sleep in order to assess the adaptive capabilities of the cardiovascular system and create accurate ranges taking into account the gender and age of the subjects. Studies revealing relationship between quality of sleep and the features of neurohumoral regulation of the sinus node in the diagnosis of sleep disorders are also considered relevant.

**Keywords:** heart rate variability, circadian rhythms, sleep phases, quality characteristics of sleep.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_4

UDC 611.2; 796

### **INFLUENCE OF LOAD RATE ON MAXIMUM OXYGEN CONSUMPTION DURING UPPER-BODY TESTING: A SYSTEMATIC REVIEW**

**V.V. Volkov, R.V. Tambovtseva**

Russian University of Sports "GTSOLIFK", Moscow, Russia

**Abstract.** It has been shown that maximum oxygen consumption when working on a bicycle ergometer and treadmill does not depend on the duration of the testing protocol over a wide time range. At the same time, arm crank ergometers are used to solve some problems in clinical and sports functional diagnostics. The aim of the study was to conduct a systematic review of the scientific literature on the effect of load rate in a step test with hand work on maximum oxygen consumption. The electronic databases PubMed/MEDLINE and the Cochrane Library were searched from the moment of their creation to August 1, 2023. This review included four studies that met the inclusion criteria and revealed that maximum oxygen consumption was independent of load rate in incremental tests on arm crank ergometers.

**Keywords:** maximum oxygen consumption, functional diagnostics, load test, arm crank ergometer.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_5

UDC 796.01; 612.33

## **INTESTINE AS A NODAL POINT IN THE BODY IN OVERTRAINING SYNDROME**

**T.R. Gabitov, A.L. Yasenyavskaya**

Astrakhan State Medical University, Astrakhan, Russia

**Abstract.** This review article discusses the role of the intestine in overtraining syndrome. As part of the digestive system, the intestine is an important nodal point in the human body, where numerous physiological processes take place, including absorption of nutrients and synthesis of amino acids. In overtraining syndrome, the general acidification of the body leads to disorders in the physiological functions of many of its systems, including the digestive system. Suppression of normal intestinal functions due to the excessive training activity in athletes leads to a pathological state in which the body ceases to synthesize new proteins sufficiently in the process of muscle hypertrophy, and also sharply increases the risk of mental disorders due to the distorted production of some amino acids, tryptophan in particular. In the course of the review, on the example of numerous studies, we thoroughly examine the mechanisms of the above-described pathological changes in the state of an athlete's body against the background of the experienced overtraining syndrome.

**Keywords:** sport, training, intestine, overtraining, hypertrophy, central nervous system.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_6

UDC 378.178

## **FACTORS AFFECTING MENTAL PERFORMANCE OF STUDENTS (LITERATURE REVIEW)**

**A.A. Govorukhina, A.A. Levchuk**

Surgut State Pedagogical University, Surgut, Russia

**Abstract.** This study contains a theoretical analysis of foreign and domestic studies of students' mental performance. Different approaches (psychological, pedagogical, physiological) to revealing the content of the mental performance concept are demonstrated. The approaches and research results of many scientists in identifying the influence of exogenous and endogenous factors on mental performance are also shown. Attention is focused on the influence of stressful conditions, work and rest regimes, individual and typological characteristics of the individual on the mental performance indices of students.

**Keywords:** adaptation, mental performance, fatigue, exogenous and endogenous factors, students.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_7

UDC 581.1; 615.017

## **SOME FEATURES OF CHANGES IN THE NERVOUS SYSTEM OF RAT OFFSPRING UNDER EFFECT OF PLANT ANTIOXIDANTS**

**S.N. Klychkova, O.N. Pavlova, O.N. Gulenko**

Samara State Medical University, Samara, Russia

**Abstract.** Increased anxiety is an adaptive mechanism that helps the body cope with potentially dangerous situations. This mechanism is related to the evolutionarily reinforced "fight-or-flight" response allowing a rapid reaction to threats and dangers. The result of activation of the nervous system and stress response system is a change in the behavior of living beings. To reduce the anxiety level, the duration of its indices, as well as the severity of depression, there are various behavioral methods that allow us to compare data on the emotional state of animals from the

control and experimental groups. Purpose of the study: to investigate the features of changes in the nervous system of rat offspring under effect of plant antioxidants. Conclusions: water extracts of bush blackberry, as well as a mixture of water extracts of bush blackberry and reddish hellebore have a modelling effect that reduces the level of anxiety and depression.

**Keywords:** antioxidants, elevated plus maze, rats, forced swim test, nervous system, bush blackberry, reddish hellebore.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_8

UDC 57.024

### **DELAYED EFFECTS OF PRENATAL STRESS AND CEREBROLYSIN ON ANXIETY AND INVESTIGATIVE BEHAVIOR OF MALE RATS**

**O.N. Kuleshova, L.A. Yakovenkova**

Astrakhan State University named after V.N. Tatishchev, Astrakhan, Russia

**Abstract.** A study was conducted on the level of anxiety, motor activity and investigative behavior, as well as the level of sensorimotor disintegration in adult outbred male albino rats, whose mothers received the neuroprotector Cerebrolysin during pregnancy while experiencing immobilizing stress. In order to do this, 4-6 months old pregnant females were divided into 4 groups: intact, stress group (were immobilized for 1 hour), a group of animals receiving Cerebrolysin injections (1 mg per 1 kg of weight), and a group receiving Cerebrolysin injections simultaneously while being stressed. The offspring of these females (72 males) at the age of 4 months were tested in the beam walking test setup. Prenatal stress increased the anxiety level of mature male rats. Prenatal stress and Cerebrolysin reduced anxiety and increased investigative activity in mature males. The activity parameters did not return to the control values. The neuroprotector Cerebrolysin may be considered as a substance that alleviates the negative effects of prenatal stress, reduces anxiety levels and increases the investigative activity of male rats. This drug requires further research and study of the mechanisms of its influence on behavior.

**Keywords:** prenatal stress, male rats, mature, behavior, anxiety, Cerebrolysin, neuroprotector, beam walking test, investigative behavior.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_9

UDC 612.133; 612.135; 796/799

### **COMPARATIVE ANALYSIS OF MICROCIRCULATORY RESPONSE TO PHYSICAL ACTIVITY OF BASKETBALL PLAYERS**

**F.B. Litvin<sup>1</sup>, K.A. Krotova<sup>1</sup>, V.Ya. Zhigalo<sup>2</sup>, A.I. Kalosha<sup>3</sup>**

<sup>1</sup>Smolensk State University of Sports, Smolensk, Russia

<sup>2</sup>Bryansk State University of Engineering and Technology, Bryansk, Russia

<sup>3</sup>Ivan Petrovsky Bryansk State University, Bryansk, Russia

**Abstract.** The aim of the study was to examine the functional asymmetry features of the microcirculatory bed of the upper and lower limbs in basketball players using wearable devices. The study included 30 athletes aged 17-22 years. Functional asymmetry in the cranial-caudal and left-right directions has been identified with laser Doppler flowmetry and fluorescence spectroscopy. At rest, the microcirculation intensity, the amount of nutritive blood flow and the amount of oxidative metabolism are higher in the upper limbs. The index of nutritive blood flow is directly dependent on the magnitude of the myogenic oscillation amplitude. In the lower limbs, the index of nutritive blood flow is lower compared to the upper limbs due to the low myogenic oscillation amplitude. Left-right asymmetry is more pronounced on the lower limbs. The exercise test showed the preservation of patterns of cranial-caudal and left-right functional asymmetry at higher values of the studied parameters. After physical activity on the upper and lower limbs, the

indices of microcirculation intensity and the value of nutritive blood flow significantly increase. There is a pronounced vasodilatory reaction of precapillary sphincters. The level of energy metabolism increases in the upper limbs and decreases in the lower limbs.

**Keywords:** athletes, microcirculation, oxidative metabolism, laser Doppler flowmetry, fluorescence spectroscopy, physical activity.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_10

UDC 612.017.2

## **SELF-ORGANIZATION OF NEURODYNAMIC PROCESSES IN ATHLETES DURING BIOFEEDBACK TRAINING OF BRAIN BETA RHYTHM OF DIFFERENT DURATION**

**N.V. Lunina<sup>1,2</sup>, Yu.V. Koryagina<sup>2</sup>**

<sup>1</sup>Russian University of Sports "GTSOLIFK", Moscow, Russia

<sup>2</sup>FSBI "North-Caucasian Federal Research and Clinical Center of the Federal Medical and Biological Agency", Essentuki, Russia

**Abstract.** The results of the quantitative and qualitative contribution of the regulatory influence of the nervous system of various levels on the functioning of the circulatory system are presented, reflecting the self-organization of neurodynamic processes in athletes under the influence of neurobiofeedback of brain beta rhythm of various duration. Correlation analysis, taking into account quantitative and qualitative connections between the studied parameters of the central and autonomic nervous system, made it possible to investigate the self-organization of neurodynamic processes, determine the degree and nature of the contribution to the regulation of the level of cortical-subcortical interactions on the functioning of the circulatory system of athletes, determine the coefficient of efficiency of adaptation of the circulatory system at the initial, intermediate (middle of the course) and the final stage of the course application of neurofeedback of brain beta rhythm. The changes of self-organization of neurodynamic processes in the interlevel interaction of the central and autonomic nervous systems during neurofeedback was reflected by a change in the number (n) of moderate and strong interactions and the values of the adaptation efficiency coefficient (CEA) at the beginning of the course (n=22, CEA=0.27 c.u.), in the middle of the course (n=25, CEA=0.24 c.u.), at the end of the course (n=40, CEA=0.48 c.u.).

**Keywords:** athletes, neurofeedback, brain rhythms, autonomic nervous system, heart rate variability, correlation analysis, relationships, adaptation efficiency coefficient, neuroplasticity, self-organization, neurodynamic processes.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_11

UDC 612.06

## **PROBLEM OF THE MALADAPTATION PROCESSES' DEVELOPMENT WHILE GETTING IN COMPETITION SHAPE**

**V.V. Myakotnykh**

Sochi State University, Sochi, Russia

**Abstract.** The article conducts a study of biological mechanisms that define the formation and loss of competition shape, from the standpoint of modern concepts on the development and interaction of adaptation and maladaptation processes in the annual cycle of athlete training. A paradox has been revealed, which consists in the impossibility of carrying out biological changes that ensure the formation of competition shape to a "state of optimal fitness for sports achievements" in any of the phases of its development. The need to make adjustments to the construction of a modern periodization system and the definition of the term "competition shape" is proven.

**Keywords:** periodization, sports training, competition shape, adaptation, maladaptation.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_12  
UDC 612.176.4

### **HEART RATE VARIABILITY UNDER COGNITIVE LOAD DEPENDING ON THE REACTIVITY OF THE SYMPATHETIC DIVISION OF THE AUTONOMIC NERVOUS SYSTEM IN MEDICAL UNIVERSITY STUDENTS**

**T.M. Nikolaeva, E.K. Golubeva**

Ivanovo State Medical Academy, Ivanovo, Russia

**Abstract.** The changes of heart rate indices during cognitive activity may be identified by the degree of tension and features of the reactivity of the autonomic nervous system (ANS). The purpose of the study is to assess heart rate variability under cognitive load in students with different reactivity of the sympathetic nervous system. The reactivity of the sympathetic nervous system was assessed by the features of changes in heart rate in an active orthostatic test. Under cognitive load, similar changes in heart rate variability occur in students with normal and hypersympathetic reactivity, associated with an increased effect of the ANS sympathetic component. In subjects with increased sympathetic reactivity, the correction test initiates a more pronounced adaptation response, which is ensured by greater tension in the regulatory mechanisms.

**Keywords:** heart rate variability, cognitive load, reactivity of the sympathetic division of the autonomic nervous system.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_13  
UDC 612.7;612.8;796.4;796.8;796.9

### **THE MODEL OF THE CONCEPT OF THE HUMAN MOTOR SYSTEM FUNCTION DURING SPORTS ACTIVITY**

**S.V. Nopin**

FSBI “North-Caucasian Federal Research and Clinical Center of Federal Medical and Biological Agency”, Essentuki, Russia

**Abstract.** The purpose of the work is to develop and scientifically substantiate the concept of the human motor system (MS) function during sports activities. Comprehensive theoretical and experimental studies of the MS of athletes were carried out in the Center for Medical and Biological Technologies of the North-Caucasian Federal Research-Clinical Center of Federal Medical and Biological Agency. The concept of the human MS function during sports activity that we have developed reveals the constituent elements of this system, as well as the principles of their arrangement and interaction to ensure the effective execution of movements in sports and consists of four interconnected blocks. The first one includes sensory pathways and structural elements: cortical and subcortical motor centers that implement movements and their regulation. The second block defines the functions of the first block’s structural elements: individual reflexes for making involuntary movements and maintaining posture; voluntary movements; sensory and operant (instrumental) reflexes; creation of functional systems for the implementation of individual motor functions. The third block of the concept is defined by the implementation of functions in complex sports movements – in the manifestations of motor abilities/qualities: strength, speed, agility in the form of specialized neuromotor, electrophysiological, biomechanical elements of the MS. The fourth block defines the result of the MS functions in sports movements, i.e. the maximum and model characteristics of functional reserve capabilities, the relationship of the functional characteristics of the MS of athletes during sports activity.

**Keywords:** athletes, motor system, concept, adaptation to muscular activity, functional systems, motor qualities, neuromotor skills, biomechanics, physiological reserves.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_14  
UDC 612.1/.8; 612.824

### **BLOOD-BRAIN BARRIER: DEFINING STRUCTURES AND FUNCTIONS**

**T.I. Okonenko, A.P. Novikova, E.E. Rumyantsev**

Yaroslav-the-Wise Novgorod State University, Veliky Novgorod, Russia

**Abstract.** The article is devoted to the review of modern studies of the basic structural and functional properties of the blood-brain barrier in humans, as well as to the description of known models of its function and ways to influence it. The introduction describes the main components of the blood-brain barrier, further describing the details of its cellular and molecular structure. This is followed by an overview of known mechanisms of passive and active transport of substances with different physicochemical properties. The concluding chapter describes known models for studying the properties, function of the blood-brain barrier and provides an overview of promising ways to influence its permeability and ways to increase the efficiency of drug transport through the barrier.

**Keywords:** blood-brain barrier, endotheliocytes, pericytes, tight junctions, transport systems.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_15  
UDC 57.056

### **FUNCTIONAL STATE OF THE CARDIORESPIRATORY SYSTEM OF MATURE WOMEN WITH DIFFERENT TYPES OF AUTONOMIC REGULATION**

**T.A. Panchenkova, O.N. Kudrya**

Siberian State University of Physical Culture and Sport, Omsk, Russia

**Abstract.** The aim of the study was to assess the functional state of the cardiorespiratory system of mature women with different types of autonomic regulation. During the study, it was revealed that there are differences between mature women with different types of autonomic regulation in terms of central and peripheral hemodynamics, the state of regulatory mechanisms of cardiac activity, oxidative capabilities of the body, consistency in the work of the cardiovascular and respiratory systems. A significant decrease in the functional state of the cardiorespiratory system was revealed in women with increased activity of the sympathetic part of the autonomic nervous system. The results of the study allow us to give a physiological justification for a differentiated approach in the selection of types of motor activity, means of physical culture, load components for mature women with different types of autonomic regulation.

**Keywords:** cardiorespiratory system, autonomic regulation, functional state, mature age, women.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_16  
UDC 612.825:001.891-057.4

### **ELECTROENCEPHALOGRAPHIC INDICES IN HIGH SCHOOL TEACHERS DURING FULL-TIME AND DISTANCE LEARNING: GENDER DIFFERENCES**

**M.A. Popova, V.V. Chistova**

Surgut State Pedagogical University, Surgut, Russia

**Abstract.** The article presents results of a study on changes in electroencephalographic indices of male and female high school teachers in full-time and distance learning. During full-time

teaching, functional brain activity is higher among male teachers compared to female teachers. When teaching remotely, functional brain activity is higher among female teachers than male ones. When planning the educational process to increase its effectiveness, it is necessary to take into account gender differences in the functional brain activity during full-time and distance learning.

**Keywords:** high school teachers, functional brain activity, electroencephalography, stereotype in professional activity, full-time teaching, distance teaching, gender differences.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_17  
UDC 612.172.2

### **HEART RATE VARIABILITY IN POSTURAL CHANGES IN WOMEN**

**D.A. Skorpupkin, E.K. Golubeva, L.L. Yarchenkova**

Ivanovo State Medical Academy, Ivanovo, Russia

**Abstract.** The heart rate variability with changes in body position in women was studied depending on the autonomic nervous system tone and the menstrual cycle phase. The work was carried out with participation of 50 women aged 18-20 years. Electrocardiogram was recorded in the follicular and luteal phases of the menstrual cycle in the supine position, with active, passive orthostasis and passive antiorthostasis. Active orthostasis initiates the sympathetic system excitation, which is more pronounced in vagotonics. Passive orthostasis also increases sympathetic activity, especially in normotonics. The changes are mainly manifested in the follicular phase of the cycle. Passive antiorthostasis leads to an increase in parasympathetic effects in normotonics and sympathetic effects in sympathotonics only in the follicular phase.

**Keywords:** heart rate variability, postural changes, autonomic nervous system, menstrual cycle.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_18  
UDC 796.01:612

### **MODIFIED GRAPHICAL METHOD FOR IDENTIFYING METABOLIC THRESHOLDS IN RUNNING**

**T.S. Spirin<sup>1</sup>, A.I. Chikurov<sup>1</sup>, E.I. Kovel<sup>2</sup>**

<sup>1</sup>Siberian Federal University, Krasnoyarsk, Russia

<sup>2</sup>Yars LLC, Krasnoyarsk, Russia

**Abstract.** The study presents general information on the concept of aerobic and anaerobic metabolic transition, in which  $VO_2max$ , aerobic and anaerobic thresholds are characteristic points of this transition. An experimental study was conducted on 18 trained recreational runners. The levels of metabolic thresholds were identified using the dynamics of lactate concentration in capillary blood, as well as a modified graphical method based on the analysis of heart rate dynamics. The approach that allows using the aforementioned method to determine the level of lactate threshold among recreational runners with a possible variation of running speed from -1.39 to 1.15 km/h (95% CI) was substantiated. Thus, with this method, it is possible to identify not only the anaerobic, but also aerobic threshold. This makes it possible to establish the intensity zones of different types of training based on the results of a single test.

**Keywords:** anaerobic threshold, aerobic threshold, graphical method.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_19  
UDC 591.18; 577.112.386

### **INFLUENCE OF SCUTELLARIA BAICALENSIS EXTRACT ON HOMOCYSTEINE LEVEL UNDER CONDITIONS OF "SOCIAL" STRESS**

**V.V. Uranova<sup>1</sup>, N.A. Lomteva<sup>2</sup>, O.V. Bliznyak<sup>1</sup>, S.V. Komarov<sup>1</sup>**

<sup>1</sup>Astrakhan State Medical University, Astrakhan, Russia

<sup>2</sup>Astrakhan State University named after V.N. Tatishchev, Astrakhan, Russia

**Abstract.** This study is devoted to studying the effect of *Scutellaria baicalensis* extract on homocysteine (Hcy) levels under normal conditions and under conditions of “social” stress. An extract from the *Scutellaria baicalensis* roots, obtained by maceration, was used as a potentially active drug. The experiment involved 80 animals, which were divided into six groups. The extract was administered to individuals at a dosage of 100 mg/kg/day. Control groups received water for injection in the same volume as the experimental agent (0.2 ml). A pathological stress state was created through the formation of intermale confrontations. To study the Hcy content, seven animals from each group were selected, whose blood was obtained by decapitation. Serum Hcy levels were analyzed by high performance liquid chromatography with ultraviolet detection at 330 nm. The data obtained as a result of the experimental study indicate a statistically significant increase in the Hcy concentration under conditions of “social” stress in the control group of aggressors and victims relative to intact animals. It was found that the introduction of *Scutellaria baicalensis* extract led to a significant decrease in the content of the studied sulfur-containing amino acid. Consequently, the extract under study has a corrective effect on the level of Hcy in anxiety and depressive disorders caused by intermale confrontations.

**Keywords:** anxiety-depressive disorders, “social” stress, hyperhomocysteinemia, homocysteine, *Lamiaceae*, *Scutellaria baicalensis*, plant raw materials, extract.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_20

UDC 612.13; 616.1

## **ASSESSMENT OF HEART RATE VARIABILITY IN RELATION TO EATING DISORDERS AND OVERWEIGHT IN MATURE WOMEN**

**O.V. Filatova, E.I. Romashko, E.V. Kutseva, I.Yu. Voronina**

Altai State University, Barnaul, Russia

**Abstract.** Aim: to study the characteristics of heart rate autonomic regulation in mature women with different eating behavior styles. A decrease in the parasympathetic influence on the heart rate is shown in women with the emotional and restrictive eating styles. The predominance of the humoral and metabolic level of heart rate regulation was revealed in the group of women with the external eating style. We have also registered an increase in the parasympathetic influence on heart rate regulation in people with increased body mass index and body fat mass. In the group of people with increased body fat mass, we could separately distinguish a group of people with the emotional eating style: the sympathetic division of the autonomic nervous system predominates in heart rate regulation.

**Keywords:** eating behavior, heart rate variability, bioimpedance measurement, body fat mass, basal metabolic rate, specific basal metabolic rate.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_21

UDC 615.214

## **ASSESSMENT OF ACUTE TOXICITY OF POTENTILLA SUPINA L. EXTRACT IN LABORATORY RATS**

**A.A. Tsibizova, M.K. Makalatia, V.Kh. Murtalieva, M.U. Sergalieva**

Astrakhan State Medical University, Astrakhan, Russia

**Abstract.** The purpose of the study was to examine the acute toxicity of the *Potentilla supina* L. herb extract on white non-linear rats. The animals were divided into two groups: control group, which received purified water, and experimental groups, which were administered once intragastrically the *P. supina* extract in doses of 100, 500, 1000, 2000 and 4000 mg/kg. During observation (14 days), the animals were evaluated for overall health, appetite, coat condition, reaction to sound, light and tactile stimuli, weight was also registered. Reaction to sound stimuli was assessed by a sudden knock on the cage, as a result of which attention was paid to the flinching of the animal. Reaction to light was assessed by illuminating the eye with a flashlight and observing eyelid closure. Tactile stimuli were evaluated by squeezing the root part of the tail. After 14 days, the animals were removed from the experiment in compliance with all ethical norms. Haematological (clinical blood analysis) and macroscopic examinations of internal organs (brain, liver, spleen, heart, stomach) were performed. The LD<sub>50</sub> of the herbal extract of *P. supina* was identified during the study. When the extract was administered at a dose of 4000 mg/kg, the death of 1 animal was recorded by the 3<sup>rd</sup> day, the remaining animals showed a decrease in weight and leucocyte count. Thus, acute toxicity studies allowed us to conclude that *P. supina* herb extract is low toxic (toxicity category IV) and the LD<sub>50</sub> is 4000 mg/kg. However, taking into account the available results of toxicity assessment of other potentilla species, it is necessary to conduct detailed studies on long-term oral and intra-abdominal administration of *Potentilla supina* herb extract, as well as possible embryo- and organotoxicity.

**Keywords:** herbal medicinal products, *Potentilla supina*, extract, acute toxicity, rats.

## PSYCHOPHYSIOLOGY

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_22

UDC 612.821

### PSYCHOEMOTIONAL STATE OF 9TH AND 11TH GRADE STUDENTS

**E.I. Zavertanaya, N.I. Koshkarova**

Tyumen State Medical University, Tyumen, Russia

**Abstract.** The article contains practical data obtained during a study aimed at assessing the psychoemotional state of graduating class teenagers from two secondary schools in Tyumen. We have found significant sanitary and hygienic violations of the educational process. The purpose of the study was to assess the psychoemotional state of adolescents in grades 9 and 11 during the school year. It has been established that during the last quarter of the school year the level of psychoemotional state among 9<sup>th</sup> grade students exceeds the values compared to 11<sup>th</sup> grade adolescents. At the same time, the differences were significant at the beginning of the fourth quarter for girls, and at the end of the quarter for boys.

**Keywords:** adolescents, mental hygiene, psychophysiology, study load, psychoemotional state.

## BALNEOLOGY AND REHABILITATION

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_23  
UDC 615.825.6; 612.75

### EFFECTS OF BIOFEEDBACK MECHANOTHERAPY AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

N.V. Lunina<sup>1,2</sup>, K.A. Smirnova<sup>1</sup>

<sup>1</sup>Russian University of Sports “GTSOLIFK”, Moscow, Russia

<sup>2</sup>FSBI “North-Caucasian Federal Research and Clinical Center of the Federal Medical and Biological Agency”, Essentuki, Russia

**Abstract.** The article presents the results of using mechanotherapy with biofeedback (BF) after the anterior cruciate ligament (ACL) reconstruction. The effects of using biofeedback mechanotherapy after ACL reconstruction were reflected in an increase in hip girth by 11%, improvement of the goniometry results, increase of the angles of flexion and extension of the knee joint by 35.1% and 6.6% respectively, increase in the amplitude of the knee joint movement by 40.7%, increase in strength of the knee joint muscles when tested on the PrimusRS mechanical device. The strength of the flexor and extensor muscles improved by 19% and 24% respectively. According to the stabilometry data, the area of the movement zone increased by 122%, reflecting an improvement in the support ability of the lower limbs. According to WOMAC (Western Ontario and McMaster Universities Arthritis Index), the subjective assessment of the knee joint condition also improved by 42.7%. The results obtained indicate the effectiveness of biofeedback mechanotherapy performed after ACL reconstruction.

**Keywords:** biofeedback, mechanotherapy, anterior cruciate ligament reconstruction, knee joint.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_24  
UDC 615.8; 616.858

### THE EFFECT OF CAMPTOCORMIA ON POSTURAL CONTROL, BALANCE AND GAIT OF PATIENTS WITH PARKINSON'S DISEASE

K.M. Nazarova<sup>1,2</sup>, A.N. Nalobina<sup>1</sup>

<sup>1</sup>Moscow City University, Moscow, Russia

<sup>2</sup>National Medical Research Center for Rehabilitation and Balneology of the Ministry of Health of the Russian Federation, Moscow, Russia

**Abstract.** The article describes the effect of camptocormia on postural control, balance and walking parameters. The study involved 24 people from stage 2 to stage 4 Parkinson's disease (PD) with camptocormia and without angulation. It can be concluded that physical rehabilitation programs for patients with PD without angulation should include more physical exercises in standing positions and walking on unstable surfaces with the performance of various motor and cognitive tasks. For patients with camptocormia, it is preferable to start with sitting positions, learning coping strategies when getting up from surfaces of different heights and structures, as well as measures to improve posture, static and dynamic balance and walking in various conditions with the performance of double and triple tasks.

**Keywords:** physical rehabilitation, Parkinson's disease, camptocormia, quality of life, daily activity.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_25  
UDC 616.72-008.1-071.3

## **EFFICIENCY OF THERAPEUTIC GYMNASTICS AS ONE OF THE METHODS OF REHABILITATION OF BREAST CANCER PATIENTS WITH IMPAIRED VOLUME AND FREEDOM OF MOVEMENT IN THE SHOULDER JOINT**

**I.I. Orlov, T.I. Grushina**

Moscow Research and Practical Centre of Medical Rehabilitation, Restorative and Sports Medicine, Moscow, Russia

**Abstract.** The aim of the study was to investigate the efficiency of a single course of therapeutic gymnastics with and without additional electrical muscle stimulation in the rehabilitation of breast cancer patients with impaired volume and freedom of movement in the shoulder joint on the side of radical mastectomy. The randomized study included 60 women (average age –  $51.25 \pm 1.1$  years), who were divided into 2 comparable groups: group 1 (30 patients) received one 14-day course of therapeutic gymnastics, group 2 (30 patients) received 12 additional procedures of low-frequency electrical muscle stimulation. Before and after the rehabilitation course they underwent the shoulder joint goniometry, assessment of the scapulohumeral rhythm (SHR) coordination and strength of the main muscle groups associated with the movement of the upper limb using the MRC-SS scale. Data processing was performed with MS Excel 14.0 and Statistica 8 for Windows. As a result, an increase in shoulder joint mobility by 9% on average occurred in group 1 patients and by 6% in group 2 ( $p=0.005$ ). A SHR decrease was also found in all patients: group 1 ( $p=0.0003$ ) and group 2 ( $p=0.031$ ). The most significant increase in muscle strength was noted in group 2 patients ( $p<0.05$ ).

**Keywords:** breast cancer, shoulder joint, rehabilitation.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_26

UDC 615.825.4

## **CEREBRAL HEMODYNAMICS IN PATIENTS WITH DISCIRCULATORY ENCEPHALOPATHY WHO HAVE HAD COVID-19, WHEN SEQUENTIAL ELECTROCEREBRAL THERAPY IS ADMINISTERED IN COMPREHENSIVE TREATMENT**

**A.A. Fedorov<sup>1,2</sup>, D.A. Ladygin<sup>1,3</sup>, A.S. Kajsinova<sup>4,5</sup>**

<sup>1</sup>Ural State Medical University, Ekaterinburg, Russia

<sup>2</sup>Ekaterinburg Medical Scientific Center for Prevention and Health Protection of Workers at Enterprises, Ekaterinburg, Russia

<sup>3</sup>Nizhnyaya Tura Central City Hospital, Nizhnyaya Tura, Russia

<sup>4</sup>FSBI “North-Caucasian Federal Research-Clinical Center of FMBA of Russia”, Essentuki, Russia

<sup>5</sup>Pyatigorsk Medical and Pharmaceutical Institute, Branch of the Volgograd State Medical University, Pyatigorsk, Russia

**Abstract.** Purpose of the study: using ultrasonic dopplerography (USDG) data, to study the dynamics of cerebral hemodynamics in patients with dyscirculatory encephalopathy (DE), including those who have had COVID-19, when sequential electrocerebral therapy is prescribed in comprehensive rehabilitation treatment. At the 1<sup>st</sup> stage, comparative studies of cerebral vessels' USDG were carried out on 135 patients (60 women and 75 men), including 42 people (1 group of patients) with DE and 93 people with DE and long COVID (group 2), as well as on 30 practically healthy individuals. Age – 61 [95% CI 43; 70] years, duration of DE – 8.5 [95% CI 3; 10] years, duration of post-COVID – 3.6 [95% CI 3; 4] months. At the 2<sup>nd</sup> stage, patients with DE and long COVID were randomized into two subgroups: the control subgroup (CSG), which received standard restorative treatment, and the main subgroup (MSG), which additionally received sequential electrocerebral therapy. All patients underwent USDG of cerebral vessels on a “Sonoline Antares” digital device developed by Siemens. In a comparative analysis of the USDG parameters of the cerebral vessels of patients with DE, including those with long COVID,

and healthy individuals, significant differences were noted in the carotid and vertebral systems. After a course of procedures, patients with MSG had significant ( $p < 0.05-0.001$ ) improvement (1.2-1.8 times) in the processes of blood supply to the brain in all studied parameters (speed and index). At the same time, statistically significant ( $p < 0.05-0.01$ ), but less pronounced (1.2-1.6 times) shifts in only index values were revealed in the CSG.

**Keywords:** dyscirculatory encephalopathy, post-COVID syndrome, cerebral hemodynamics, electrocerebral therapy.

## SPORTS MEDICINE

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_27  
UDC 796.431.4; 796.422.1.093.35

### COMPARATIVE ANALYSIS OF THE INFLUENCE OF SPORTS ACTIVITY ON THE SPINE IN POLE VAULTERS AND HURDLERS

**M.A. Gapicheva**

N.K. Krupskaya Palace of Pioneers and Schoolchildren, Chelyabinsk, Russia

**Abstract.** The purpose of the work is to study the influence of prolonged sports activity on the spinal column in connection with the motor activity of qualified pole vaulters and hurdlers. The analysis was carried out according to the location of the cervical, thoracic and lumbar parts of the spinal column in projection on the frontal and sagittal planes, using the MBN 3D scanner. The study revealed that athletes, through adaptive changes, improve posture with movement in the frontal plane for hurdlers, and in the sagittal plane for pole vaulters.

**Keywords:** sports adaptation, spinal column, pole vaulting, hurdling, track-and-field, asymmetry, spinal scanner.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_28  
UDC 796.071.2+796.012.1+577.125+577.121.7+612.744.24

### LIPID SPECTRUM IN ATHLETES OF DIFFERENT LEVELS AND TRAINING SPECIFICS AT VARIOUS STATES ASSOCIATED WITH MUSCLE ACTIVITY

**A.V. Elikov**

Kirov State Medical University, Kirov, Russia

**Abstract.** The article presents an investigation on the blood plasma lipid spectrum parameters at rest, 5 minutes and 30 minutes after cycle ergometry test in 71 athletes and 15 untrained men from comparison group aged 18-25 years. The results revealed that professional athletes, especially those involved in cyclic sports, had a more favorable distribution of lipid spectrum parameters and the most powerful aerobic bioenergy. The lipid spectrum of professional athletes has a unique feature in that high-density lipoproteins may participate in maintaining the oxidant balance, which is a criteria for high levels of adaptation to physical load. The lipid spectrum indices are recommended for monitoring the athlete's functional state as they reflect the athlete's level of training.

**Keywords:** athletes, physical activity, lipid metabolism.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_29  
UDC 613.84; 796

### THE IMPACT OF E-CIGARETTES AND VAPING PRODUCTS ON THE HEALTH OF ATHLETES: A RAPID REVIEW

**A.A. Koropenko<sup>1</sup>, P.D. Rybakova<sup>2</sup>, A.B. Miroshnikov<sup>3</sup>**

<sup>1</sup>Noginsk Gymnasium, Moscow, Russia

<sup>2</sup>Center for Sports Innovative Technologies and Training of National Teams, Moscow, Russia

<sup>3</sup>Russian University of Sports "GTSOLIFK", Moscow, Russia

**Abstract.** The rapid growth in popularity of e-cigarettes or vaping has not spared athletes. The increasing use of these devices means that sports medicine physicians and trainers must be familiar with the effects of these devices on athletes. The purpose of this study: to conduct an

analysis of studies examining the effects of e-cigarettes and vaping products on the health of athletes. The study was carried out in accordance with the Cochrane Guidelines for Rapid Reviews. The literature search was performed in PubMed, MedNar, Epistemonikos and Google Scholar databases. We examined studies for ~5 years (filter by date – from 2019 to January 24, 2024). Results. A total of 2843 references were identified in the databases. As a result of search and selection, the study included 2 reviews. Until long-term, high-quality studies are conducted, it is not recommended for athletes to smoke e-cigarettes (especially brands containing nicotine).  
**Keywords:** electronic cigarettes, vapes, performance, lung diseases, cardiovascular diseases.

## PHYSICAL CULTURE AND PROFESSIONAL PHYSICAL TRAINING

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_30  
UDC 331.44; 796

### ANALYSIS OF PSYCHOPHYSICAL STRESS IN PROFESSIONAL ACTIVITY OF INFORMATION TECHNOLOGY EMPLOYEES

**A.V. Dubovik**

Siberian State University of Physical Culture and Sport, Omsk, Russia

**Abstract.** The purpose of the research was to compile and analyze a chronogram of a typical working day for information technology employees to identify the specifics of psychophysical and physical stress in professional activity (on the example of software engineers in early adulthood). An analysis of the compiled chronogram of a typical working day for employees is presented to obtain an expanded understanding of the specifics of professional activity of software engineers, the psychophysical and physical stress when performing work tasks. Unfavorable factors in professional activity of employees are: the need to remain in a static sitting position for a long time during a workday, increased load on the visual analyzer, psychophysical stress (high attention concentration, mental stress due to the intellectual and creative nature of the work), irregular working hours, insufficient motor activity.

**Keywords:** psychophysical and physical stress, chronogram of a typical working day, information technology employees, software engineers, physical inactivity.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_31  
UDC 796.011.3

### FUNCTIONAL CAPABILITIES OF STUDENTS OF THE SPECIAL MEDICAL GROUP IN PHYSICAL EDUCATION CLASSES

**E.Kh. Mazhitova<sup>1</sup>, D.E. Petin<sup>2</sup>, E.Sh. Petina<sup>1</sup>**

<sup>1</sup>Astrakhan State Medical University, Astrakhan, Russia

<sup>2</sup>“Glasson Team” martial arts school, Nizhny Novgorod, Russia

**Abstract.** The purpose of the study is to examine functional capabilities of the body and physical development of 1-3 year students in physical education classes. Students of the Astrakhan State Medical University were divided according to health status into 2 groups: special and basic medical groups. Using methods of anthropology and physiometry, a number of indices characterizing lung vital capacity and physical performance (PP) were assessed. PP was estimated with the squat test and the Harvard step test. The functional capabilities of the students' bodies were identified with the bicycle ergometer test. The results obtained reflect the need for measures to reduce stress and improve the health of students from the very beginning of their study in the university.

**Keywords:** special medical group, functional capabilities, physical performance, adaptation, readaptation.

## THEORY AND METHODS IN SPORTS

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_32  
UDC 796.

### APPLICATION OF AUXILIARY TRAINING TOOLS IN PHYSICAL TRAINING OF YOUNG JUDOKAS

**I.Yu. Gorskaya<sup>1</sup>, E.V. Kladov<sup>2</sup>, I.V. Aver'yanov<sup>3</sup>**

<sup>1</sup>Siberian State University of Physical Culture and Sport, Omsk, Russia

<sup>2</sup>Omsk State Transport University, Omsk, Russia

<sup>3</sup>Moscow City University, Moscow, Russia

**Abstract.** The purpose of the study is to substantiate the composition, combination and ratio of auxiliary measures in physical training of 11-12-year-old judokas. We have substantiated and developed physical training methods for young judokas with auxiliary tools to expand the composition and variability, through the use of elements of sports and active games, as well as elements of acrobatics, athletics, fitness, the use of additional equipment (coordination ladder, Bosu platforms, basketball, football, tennis, stuffed balls, chips, signal flags), aimed at improving the emotional state and interest in training, emphasizing the impact on the underdeveloped aspects of physical fitness.

**Keywords:** judo, physical training, motor abilities, physical condition, injuries.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_33  
UDC 796.422.12

### PREDICTORS OF ATHLETIC SELECTION OF SHORT-DISTANCE RUNNERS

**N.G. Lopina, G.I. Koval'chuk**

Siberian State University of Physical Culture and Sport, Omsk, Russia

**Abstract.** The article presents materials for studying the selection and training of athletes, taking into account the specifics of demonstrating the main components of sprint. It has been shown that the speed abilities of qualified short-distance runners are closely related to the manifestation in sports activity of the naturally conditioned lability of the visual analyzer, identified by CFFF (critical flicker fusion frequency) indices with indices of mobility and inhibition of the nervous system.

**Keywords:** selection, step length, step frequency, lability of the visual analyzer, inhibition mobility of the nervous system.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_34  
UDC 796.012.122; 796.3

### DEVELOPMENT OF GENERAL ENDURANCE WITH SETS OF SPECIAL MEASURES FOR FLOORBALL PLAYERS

**Yu.I. Sirenko, A.S. Grechko**

Dostoevsky Omsk State University, Omsk, Russia

**Abstract.** The article presents the results of the study on the development of endurance in students who play floorball. The aim of the study was to experimentally prove the influence of a set of special exercises on the functional status of athletes. The data were collected in the Department of Adaptive and Physical Culture, Dostoevsky Omsk State University. The study included 1-2

year students. The results showed that application of the set contributed to the improvement of endurance development. The obtained data correspond to scientific references and partially correspond to critical age-related periods of ontogenesis. The efficiency of training and competitive activity in floorball is mainly attributed to the level of endurance.

**Keywords:** endurance, efficiency, intensity, dynamics.

## HEALTH AND ADAPTIVE PHYSICAL CULTURE

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_35  
UDC 796

### REVIEW OF FOREIGN RESEARCH ON THE PROBLEM OF PHYSICAL FITNESS AND MOTOR ACTIVITY OF CHILDREN, ADOLESCENTS AND YOUTH

I.Yu. Gorskaya<sup>1</sup>, N.O. Platonova<sup>2</sup>, L.G. Bajmakova<sup>1</sup>

<sup>1</sup>Siberian State University of Physical Culture and Sport, Omsk, Russia

<sup>2</sup>Kerch State Marine Technological University, Kerch, Russia

**Abstract.** The aim of the study is to summarize and analyze foreign research on physical fitness and functional state of children, adolescents and young people. The conducted analytical review allows us to consider the decrease in the level of physical activity of children and youth as a universal problem expressed at the social, biomedical, pedagogical, and economic levels, regardless of a country and its level of well-being. In the analyzed sources, researchers from different countries emphasize the relevance of improving approaches to involving children and youth in regular physical education and sports. In most countries, as well as in the Russian Federation, government bodies and structures are involved in solving this problem, and the role of educational organizations and the family is also noted. Researchers from different countries share an opinion about the importance of making the fitness movement more active, finding effective tools for creating lasting motivation among the younger generation for regular sports and physical education, involving financial resources from various sources and volunteer assistance, integrating the efforts of the state, society, educational institutions, and family.

**Keywords:** physical fitness, children and adolescents, students, physical development, motor activity, functional state, motor abilities.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_36  
UDC 57.056

### AUTONOMIC REGULATION OF ATHLETES WITH HEARING LOSS WHEN CONDUCTING THE COLD PRESSOR TEST

K.S. Koshkina, E.V. Bykov, A.V. Chipyshev

Ural State University of Physical Culture, Chelyabinsk, Russia

**Abstract.** We examined heart rate autonomic regulation during the cold pressor test in athletes with sensorineural hearing loss and normal hearing. In athletes with normal hearing, both initially, during the cold pressor test and recovery after, the predominance of respiratory waves was noted, with an increase in parasympathetic effect on the heart rate. An increase in “slow second-order waves” (VLF) reflecting the activation of the suprasedgmental structure of heart rate regulation in the II-III stages of the test in athletes with hearing loss may be due to maladaptation to stress.

**Keywords:** athletes, people with disabilities, hearing deprivation, autonomic regulation, cold test, heart rate.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_37  
UDC 612.821.1

### OPTIMAL FUNCTION TRAINING IN THE TRAINING PROCESS OF SHOOTERS WITH MUSCULOSKELETAL IMPAIRMENTS

N.M. Kurch, I.G. Talamova

Siberian State University of Physical Culture and Sport, Omsk, Russia

**Abstract.** A study was conducted to experimentally substantiate the use of optimal function training methods in the training process of shooters with musculoskeletal impairments. It was found that a 12-day course conducted after training sessions contributed to an increase in the speed of reaction to light and sound by 29% and 12%, respectively, reaction to a moving object by 20% and reaction choice by 9%, which indicates an improvement in the functional state of athletes. The data obtained make it possible to discuss the effectiveness of using optimal function training in the training process of elite shooters with musculoskeletal impairments during the pre-competition training period.

**Keywords:** shooters with musculoskeletal impairments, biofeedback, optimal function training.

Publication date: 01.03.2024

DOI: 10.24412/2588-0500-2024\_08\_01\_38

UDC 616.899-053.2

## **ADAPTIVE PHYSICAL EDUCATION OF CHILDREN WITH AUTISM SPECTRUM DISORDER**

**E.Yu. Mel'nikov<sup>1</sup>, E.F. Legkaya<sup>1,2</sup>, L.S. Khodasevich<sup>1,3</sup>, A.V. Polyakova<sup>1</sup>**

<sup>1</sup>Sochi State University, Sochi, Russia

<sup>2</sup>Sochi Institute – branch of Peoples' Friendship University of Russia, Sochi, Russia

<sup>3</sup>Kuban State Medical University, Krasnodar, Russia

**Abstract.** In children with autism spectrum disorder (ASD), motor defects are shown through postural instability, impaired balance and gait, coordination problems, motor dyspraxia, and changes in the internal model. The main methodological task of adaptive physical education of children with ASD in individual and group classes is the development of the emotional motor system. Therefore, sets of exercises and methods of their implementation are aimed at increasing concentration, streamlining motor skills and reducing emotional excitability. Group classes, and especially individual and group classes, have a more significant effect than individual ones. However, before starting them, children need to master a set of exercises previously learned in individual lessons.

**Keywords:** autism spectrum disorder, children, adaptive physical education, individual and group classes.

## BIOMECHANICS AND BIOENGINEERING

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_39  
UDC 612.76

### ELASTIC MODULI OF HYPERELASTIC MODELS OF BIOLOGICAL TISSUES

S.A. Muslov<sup>1</sup>, S.D. Arutyunov<sup>1</sup>, S.S. Pertsov<sup>1,2</sup>, A.P. Anishchenko<sup>1</sup>, K.G. Karakov<sup>3</sup>, A.A. Korneev<sup>1</sup>, A.V. Em<sup>3</sup>

<sup>1</sup>Russian University of Medicine, Moscow, Russia

<sup>2</sup>Federal Research Center for Original and Prospective Biomedical and Pharmaceutical Technologies, Moscow, Russia

<sup>3</sup>Stavropol State Medical University, Stavropol, Russia

**Abstract.** For the first time, general equations have been developed for the differential elastic moduli of hyperelastic models of incompressible materials, which include biological tissues. We examined the biomaterial of aortic valve tissues as an example. Numerical values and graphs of elastic moduli were obtained depending on the degree of tissue deformation and their statistical indices. We also analyzed the moduli's numerical values from the point of view of hyperelastic models' stability. It has been found that, according to the Hill-Drucker stability criterion, all models, except the Neo-Hookean and Ogden ones, demonstrate mechanical instability in a certain deformation range. Three models (Mooney-Rivlin, Yeoh and Veronda-Westmann) are unstable in the undeformed state (the initial Young's modulus  $E_0$  is less than zero). The results obtained have potential for modeling stressed and deformed states of biological tissues and in the field of bioengineering, but further study on this issue is advised.

**Keywords:** hyperelastic models, Young's modulus, biological tissues.

Publication date: 01.03.2024  
DOI: 10.24412/2588-0500-2024\_08\_01\_40  
UDC 612.76

### ELASTIC PROPERTIES OF BIOLOGICAL TISSUES OF HUMAN AND ANIMAL ORGANS

S.A. Muslov<sup>1</sup>, S.D. Arutyunov<sup>1</sup>, S.S. Pertsov<sup>1,2</sup>, P.Yu. Sukhochev<sup>3</sup>, K.G. Karakov<sup>4</sup>, A.V. Em<sup>4</sup>

<sup>1</sup>Russian University of Medicine, Moscow, Russia

<sup>2</sup>Federal Research Center for Original and Prospective Biomedical and Pharmaceutical Technologies, Moscow, Russia

<sup>3</sup>Moscow State University, Moscow, Russia

<sup>4</sup>Stavropol State Medical University, Stavropol, Russia

**Abstract.** Linear and bilinear elastic models of human and animal biological tissues have been studied based on the literature and our own  $\sigma$ - $\varepsilon$  data. We calculated the main parameters of the models and estimated their statistical indices. The median parameters of  $E_{lin}$  and  $\varepsilon_{cr}$ ,  $E_1$ ,  $E_2$  were 1.33 MPa, 0.38, 0.019 MPa and 8.0 MPa, the coefficient of variation (CV) – 0.53 and 1.06, 0.35, 0.79 respectively. A strong correlation  $R=0.8696-0.9845$  was registered between the data obtained experimentally and computationally in the bilinear model and  $R=0.7866-0.9362$  in the linear model for urogenital organs. The outlier data points are found on the diagrams of all elastic characteristics of the models. We also examined a trilinear model of biological tissues and a fragment of its calculation in the Mathcad 15.0 package. The established numerical characteristics may be applied in computer modeling of the mechanical function of biological tissues in virtual interventions and in future work on emulating the elastic properties of biological tissues. The results obtained may also be recommended for the development of replacement materials for reconstructive surgery and have the potential for their application in tissue engineering.

**Keywords:** elastic modules, biological tissues, biomechanics.