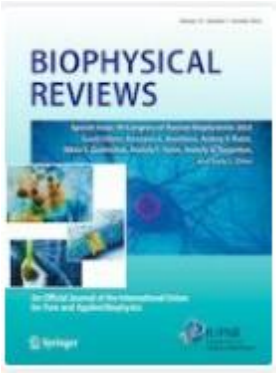

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Abstracts

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of sports of Russia (CMS) - 359.1 ± 43.9 N. The time to reach the maximum strength (0.5 and 0.6 sec) and the rate of contraction (497.5 and 544.1 N/sec) in the dischargers was less than in the athletes of the CMS, which may be due to the difference in muscle fibers in athletes of different qualifications. Apparently, white muscle fibers predominate in CMS, which are characterized by high strength, but rapid fatigue, and in dischargers – red, capable of less strength, but with slow fatigue.
The next series of experiments was aimed at the development of fatigue in athletes. We used the classical scheme of fatigue development using a dynamometer. The values of the development of the first 15-second fatigue were taken as control. When evaluating the results obtained in the studied tennis players, we found differences in all the studied indicators. The main indicator of muscle contraction is the amplitude, which was greater in the CMS with all five approaches to the dynamometer. On average, this value was 32%. The area under the fatigue development curve was also larger in the CMS and amounted to 37% with all approaches. The development of this dynamics may indicate the same energy reserves in the muscles. During the data analysis in subsequent approaches, the amplitude and area of the muscle fatigue curve decreased, both for dischargers and candidates for master of sports, but the indicators were higher for CMS. By the fifth development of fatigue, Candidates master of sports registered an increase in amplitude due to a decrease in the time to reach the maximum compared to other approaches, while it decreased for dischargers. With the fifth approach, the area of the muscle fatigue curve increased in the dischargers due to an increase in the time to reach the minimum contraction. The change in the area was accompanied by a decrease in the fatigue gradient time by 6.5%, the fatigue amplitude by 30%, the strength at the end of the fatigue development approach by 32%, the speed before fatigue by 37%, while the reduction rate decreased until the third approach of fatigue development, after which it increased for dischargers, and the time to reach maximum strength was higher the CMS has only the first and third approaches. The higher the level of sports qualification of tennis players, the higher the indicators of the compression force of the dynamometer. In all approaches to the development of fatigue, except for the first, the dischargers observed a faster time to achieve maximum fatigue indicators than the tennis players higher in rank.
The dischargers held the average dynamometer values for a longer time than the Candidates for the master of sports of Russia. Apparently, this is due to the formation of cortical and subcortical motor acts that activate the work of muscles, as well as significant improvement of intermuscular and intramuscular coordination mechanisms of movement control in athletes of higher qualifications.

7S4.238. Evaluation of postural stability of healthy people during transcutaneous electrical stimulation of the lumbar and cervical spinal cord at a frequency of 1 and 5 Hz

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Relevance.
One of the ways to modulate the neural circuits of the spinal cord was presented by a non-invasive method of transcutaneous electrical spinal cord stimulation (TSCS). The TSESM method is applicable both for studying the principles of regulation of locomotor functions in people with no motor disorders, and for selecting rehabilitation methods for patients with impaired motor function [1]. It was shown that with the help of the TSESM method, the regulation of locomotor functions in apparently healthy individuals becomes possible [2].
Objective.To evaluate the effectiveness of the impact of transcutaneous spinal cord stimulation at the lumbar (Th11-Th12) and cervical (C5-C6) levels with a frequency of 1 and 5 Hz on the indicators of postural stability in apparently healthy individuals.
Materials and methods.In the process of work, 67 people (7 men and 60 women) were examined, aged from 20 to 40 years. All studies were conducted with the informed voluntary consent of the participants in accordance with the Declaration of Helsinki. The study protocol was approved by the Local Ethics Committee of the Federal State Autonomous Educational Institution of Higher Education KFU (protocol No. 34 dated January 27, 2022).
The assessment of postural stability of the subject before and after TSCS was carried out using the Stabilan-01 stabilographic platform.
At the first stage, a control test (K) was carried out, stabilometric testing in a calm stance, with open eyes without stimulation, lasting eleven minutes.
After a 10-minute break, stabilometric testing was performed in a free stance, with stimulation - an 11-minute examination, according to the scheme:
1st minute: recording without stimulation in order to adapt the subject to the stand on the stabilographic platform;
From the 2nd to the 6th minute (total difficulty 5 minutes): with stimulation;
From 7th to 11th minutes (total difficulty 5 minutes): no stimulation, recording after stimulation.
Each subject underwent a series of 11-minute examinations, consisting of 3 samples: control, TSCS of the cervical spinal cord at the level of C5-6 cervical vertebrae and lumbar stimulation at the level of Th11-12 thoracic vertebrae.
Spinal cord stimulation. TSCS at the T11-12 level was performed using the Neurosoft MVP-8 stimulator (RF). The cathode stimulating the self-adhesive electrode was placed between the spinous processes of Th11–Th12 vertebrae.
A five-channel BIOSTIM-5 stimulator (Cosyma Ltd., Russia) was used to perform TSCS at the level of the cervical spinal cord. A stimulating skin round electrode (cathode) with an adhesive layer 32 mm in diameter was placed on the skin between the spinous processes of C5 and C6 vertebrae, rectangular electrodes (anode) with an adhesive layer 45 × 80 mm in size were placed symmetrically on the clavicles.
Stimulation was carried out by rectangular bipolar pulses with a duration of 1.0 ms, the stimulus intensity varied in the range from 50 to 70 mA. The duration of stimulation was 5 minutes. During the study, the indicators of the state of the cardiovascular system (heart rate, blood pressure) were monitored.
Statistical processing and analysis of the obtained data were carried out using the SigmaPlot 12.0 program.
Results and discussion.
When performing a control test, it was found that in a calm stance with visual control when standing on a hard surface, the subjects demonstrated the ability to maintain balance. So, after eleven minutes, compared with the first minute, the displacement of the CP along the frontal axis remained at the initial level, along the sagittal axis it decreased, the length of the trajectory of the CP along the frontal and sagittal axes, as well as the angular average velocity did not change.
TSCS at the level of the cervical and lumbar spinal cord revealed that stimulation at a frequency of 5 Hz had a positive effect on the change in stabilographic parameters: the average angular velocity increased, the area of the ellipse decreased, the length of the CP trajectory along the sagittal axis decreased, while stimulation at the level of Th11- 12 was more efficient. As one of the possible explanations for the improvement in postural stability during TSCS, an increase in synaptic conduction, as well as an increase in the excitability of afferent inputs, is given [3].
TSCS with a stimulation frequency of 1 Hz of both the cervical and lumbar spinal cord worsened the function of maintaining a vertical posture in a person.
The results of our research suggest that using the TESCM method it is possible to positively influence the functioning of spinal neural

networks in people with impaired motor functions, thereby increasing the quality of motor abilities.
Source of financing.The work was carried out within the framework of the program "Strategic Academic Leadership of the Kazan Federal University" (PRIORITET-2030).
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S4.239. Expression of heat shock protein 90 on the plasma membrane of human fibrosarcoma HT1080 cells under different physiological conditions

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Cell migration is a complex biophysical process, which is the directional movement of one or a group of cells in response to a number of biochemical (cytokines, chemokines, growth factors) and biophysical signals, both extracellular and intracellular. Cellular migration, based on the functioning of the actin-myosin complex, plays a critical role in many physiological and pathological processes: in the embryonic development of organisms, in wound healing, metastasis of tumor cells, tissue remodeling. Heat shock protein 90 (Hsp90), performing important intracellular functions associated with its chaperone activity, is known to be actively secreted into the external environment and expressed on the cell surface. Extracellular Hsp90 functions as a motogen, stimulates the processes of cell migration and invasion in vitro, participates in the processes of wound healing and metastasis of tumor cells in vivo. There are two isoforms of Hsp90: the inducible isoform Hsp90α and the constitutive isoform Hsp90β. Hsp90α is considered to be a more effective stimulator of cell migration and invasion than Hsp90β. The mechanism of action of extracellular Hsp90 is based on receptor-dependent activation of signaling pathways that provide cell motility. The main Hsp90 receptors are LRP1 and HER2. It has been shown that in addition to protein receptors, surface cellular heparan sulfate proteoglycans (HSPG) play an important role in the binding of Hsp90 on the plasma membrane. The role of HSPG interaction with membrane-associated Hsp90 in the processes of cell migration/invasion is currently unclear; however, desulfation and degradation of HSPG leads to a significant loss of membrane-associated Hsp90 from the plasma cell membrane, which correlates with reduced cell motility. Yet, the expression of Hsp90 on the cell membrane in different cell types and under different physiological conditions has not been sufficiently studied.
The purpose of the study was an analysis of the membrane expression of two Hsp90 isoforms in human fibrosarcoma HT1080 cells under different physiological conditions. Immunofluorescence combined with registration using flow cytofluorimetry was used to study the membrane expression of Hsp90. Membrane-associated Hsp90s of HT1080 cells were stained using Hsp90α- and Hsp90β-specific antibodies, secondary anti-species Alexa488-labeled antibodies, with subsequent detection of the results using a CytoFLEX flow cytometer (Beckman Coulter). Cells were treated with heparin, a competitive inhibitor of Hsp90 binding to HSPG, to discriminate Hsp90s associated with protein receptors from those bound with HSPG.
Hsp90 plays an important role in cell migration, despite the low level of Hsp90 on the plasma membrane of HT1080 cells (the amount of membrane-associated Hsp90 is 500 – 1000 times lower compared to intracellular Hsp90), since the treatment of cells with Hsp90-specific polyclonal rabbit antibodies resulted in a decrease in migration and invasion of HT1080 cells in vitro. Membrane-associated Hsp90α and Hsp90β differed significantly in the affinity of interaction with HSPG: Hsp90β was significantly more sensitive to heparin compared to Hsp90α. Dissociation of Hsp90β from HSPG was observed already at 20 μg/ml heparin, while dissociation of Hsp90α started only at 50 μg/ml. In cells at exponential and stationary growth phases, the portion of Hsp90a associated with HSPG was 30-50%, while the portion of HSPG-associated Hsp90β was 60-80%. During the transition from the exponential to the stationary phase of cell growth, a 30-40% decrease in the level of Hsp90α and Hsp90β on the cell surface was observed. At the same time, the reduced expression of Hsp90α and Hsp90β on the membrane was due to a decrease in the number of HSPG-bound Hsp90, while the level of Hsp90 associated with protein receptors was virtually independent from the phase of cell growth.
It was shown that 24 h cultivation of HT1080 cells in the absence of serum leads to a slight decrease in the membrane expression of Hsp90α (by about 10%), while about 75% of Hsp90α was associated with protein receptors. Cells cultured in a medium with serum, had 60-70% receptor-bound Hsp90α. In contrast to Hsp90α, the level of Hsp90β on the plasma membrane of cells after "serum starvation" decreased sharply (by about 70%) mainly due to the loss of HSPG-associated Hsp90β, while the level of receptor-bound Hsp90β remained virtually the same in cells cultured in serum-free medium and medium with serum.
Following 2 h after culture medium replacement or simple medium stirring without replacement led to a 40-50% increase in the level of membrane-associated Hsp90α and Hsp90β compared with cells in still culture flasks. We believe that these manipulations mediated changes in the cellular microenvironment, which significantly affected the expression of Hsp90α and Hsp90β on the cell surface.
Thus, we found that the membrane expression of two isoforms of Hsp90, which play an important role in a complex biophysical process of cell migration, significantly depends on the conditions of cell culture. At the same time, the greatest changes in the membrane expression were observed in Hsp90β, while Hsp90α was less susceptible to changes. In less favorable physiological conditions (stationary phase growth of cells, absence of serum), the level of HSPG-associated Hsp90α and Hsp90β decreased. At present, the dependence of cell proliferation and migration from the levels of membrane-associated Hsp90α and Hsp90β is unclear. Further research is also needed to clarify the mechanism of Hsp90 translocation to the membrane and the role of HSPG in this process.

S4.240. Features of postural balance of young badminton players

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Introduction. Badminton refers to situational sports, where during the game the athlete has to constantly move around the court and simultaneously monitor the actions of the opponent and the shuttlecock, which undoubtedly places high demands on the balance function of the athlete. The balance function is the sum of actions that implement postural control through various sensory systems, and the reliability of the functioning of these components will to a certain extent depend on the