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DEVELOPMENT OF AN INTERVAL DYNAMOMETRIC FUNCTIONAL TEST

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Abstract. An interval dynamometric functional test is proposed and tested, designed to assess the level of voluntary regulation of muscle effort implemented in the isometric mode. A brief overview shows an analysis of the factors that determine and influence the voluntary regulation of muscle effort. The target audience of this sample is professional climbers. The functional test is conducted in inpatient conditions of a laboratory in compliance with standard regulations and requirements to such observations. It is advisable to use a digital dynamometer, for example, the NS-Psychotest complex. The design of a functional test using an electronic dynamometer is presented.

Keywords: functional test, muscle effort, isometric muscle contraction, regulation, interval mode.

Introduction. Among factors defining physical (functional) fitness, muscle strength is a biological predictor of a state of health in the ontogenetic aspect. Moreover, in the practice of sports medicine and physiology, assessment of strength-related parameters is a criterion of effectiveness of restorative processes, as well as musculoskeletal, cardiovascular and neurological rehabilitation.

In modern studies the assessment of such parameters is realized with a number of hardware and software complexes: Lafayette, Microfet 2, Fet 2 Hoggan Health Industries, GT-10, Biodex, J Tech et al. [1]. Dynamometry is an integral part of muscle function study when assessing performance of athletes [2, 3]. However the specificity of such method, aside from study tasks, is defined by features of a certain sport. A typical movement technique and its efficiency depend on how well the neuromuscular profile of an athlete is formed.

Regardless of many existing protocols of dynamometric studies, there is a number of specific factors, consideration of which increases reliability of isometric strength assessment: standardization (unification), content of instruction, degree of muscle pre-tension, position of body parts (e.g. limbs), joint angle, range of motion, types of stabilization and fixation; speed, testing sequence, rest intervals, feedback, etc. [4]. For example, it has been found that the reliability of isometric strength testing of upper and lower body muscles increases when they are repeated twice regardless of the gender of the subjects [5]. An analysis of the strength-time ratio and the frequency of surface electromyographic signals during the isometric hand grip test revealed the optimal duration of the test muscle tension – 10 seconds [6].

In addition, quality of measuring strength-related indicators depends also on age and gender peculiarities [7], body mass (composition in particular [8]) and length, as well as the level of fitness and motor asymmetry. Thus F. Pournasiri et al (2023) showed a negative effect of the follicular and luteal phases of the menstrual cycle on strength of knee flexor and extensor muscles, which is manifested in an increased risk of the anterior cruciate ligament injury [9].

At the same time, sources describe a number of neural, mechanical and methodological factors that negate the value of isometric strength assessment in the context of a holistic motor act, much less the dynamic characterization of locomotion and its series [10].

In the systematic review, based on the COSMIN standards (an initiative of an international interdisciplinary group of researchers with expertise in epidemiology, psychometrics, medicine, qualitative research and public health who have experience in developing and evaluating outcome measurement tools (https://www.cosmin.nl/)), only three of the 15 papers on dynamometric studies demonstrated satisfactory methodological quality. The low methodological quality of the studies is due to small sample size (less than 20); high variability in the observation

time interval (from 1 minute to 14 days); lack of randomization [1].

Objective of the study: a development of a functional test – a dynamometric assessment of isometric strength of finger flexor muscles, implemented in the interval isometric mode (increase in the tension of contractile elements without detecting changes in muscle length or joint position). The target audience of this test is professional climbers.

Studies of strength performance in predominantly carpal dynamometry in climbers are few and are usually accompanied by the concurrent use of electromyography [11]; near-infrared spectroscopy [12] of the superficial finger flexor.

The climber study models are reduced to estimations of strength parameters during repeated isometric contractions of the finger flexor muscles. Thus, in the work of F. Quaine et al. (2003), the study protocol included repetition of holding muscle effort equal to 80% of the maximum isometric strength with 5-second breaks [11]. D. MacLeod et al. (2007) proposed an isometric endurance test at 40% of maximum isometric strength with repeated 10-second force holds with 3-second rests in between [12]. In the literature, the problem of validity and reliability of climbing-specific tests is being updated [13].

Methods and organization. The functional test is conducted in inpatient conditions of a laboratory in compliance with standard regulations and requirements to such observations. It is advisable to use a digital dynamometer, for example, the NS-Psychotest complex.

The exclusion criteria of participants before the dynamometric interval test:

1) participation in sports at a competitive level;

2) trauma (post-traumatic period), degenerative or neuromuscular skeletal disease;

3) taking medications that could affect muscle strength immediately prior to the assessment (e.g. muscle relaxants, pain killers, etc.);

4) exclusion of examination of girls during the follicular and luteal phases of the menstrual cycle.

Results and discussion. Taking into account rather unified requirements to the development of the research protocol with load testing, the development of an interval dynamometric functional test as a specific tool modelling and evaluating the degree of neuromuscular fatigue development in professional climbers is in demand.

The test consisted of performing a series of dynamometric exercises in the isometric mode with a wrist dynamometer. The test imitates cyclic load typical for climbing, where a repetitive forearm and finger muscle tension is required.

Brief study protocol. The test is conducted in inpatient conditions of a laboratory. The leading hand of the test subject is bent at the elbow joint (45°), the forearm is fixed on a horizontal platform, the palm turned upwards (fig. 1).

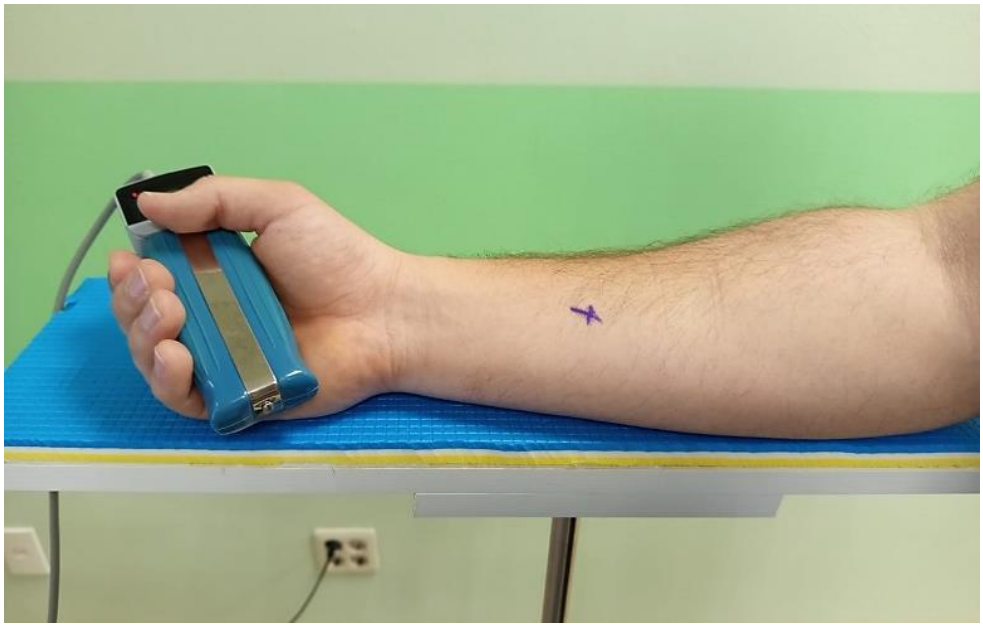

Fig. 1. Hand position in the test

The subject performs a series of submaximal muscle effort (squeezing the dynamometer) with preset rest intervals: 10 contractions with an effort of 75% of the maximum; the interval between efforts is 3 seconds (fig. 2, 3).

Three series are performed, with a 2-minute rest interval between them (fig. 4). The strength of each contraction, effort holding time, strength endurance, and fatigue coefficient (strength reduction by the end of the test in % of the initial level) are recorded.

This variant of an interval dynamometric test is designed to simulate muscle fatigue and assess urgent recovery of muscular endurance as a result of percussion massage of finger flexor muscles.

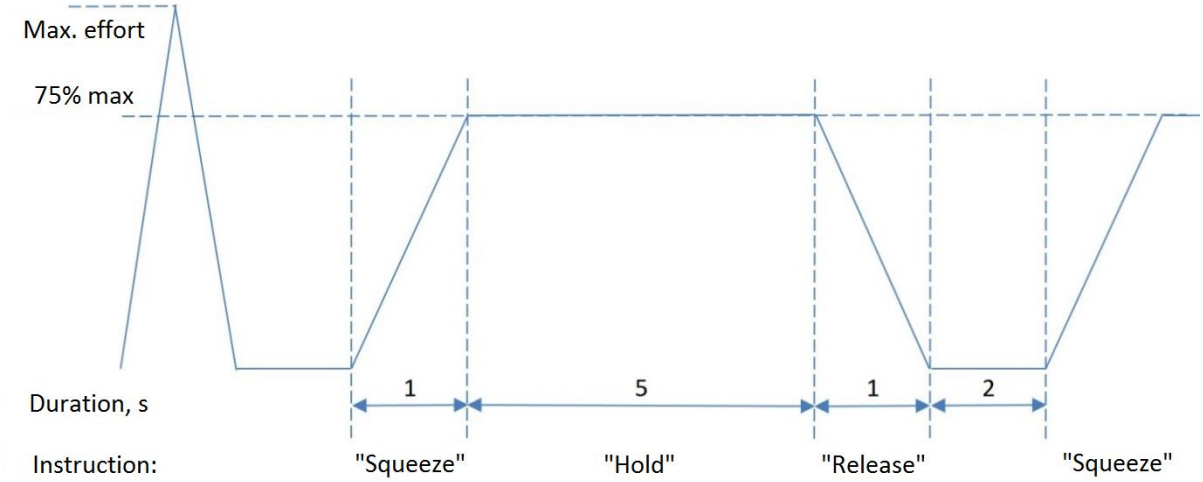

Fig. 2. Temporal characteristics of one cycle in sample series

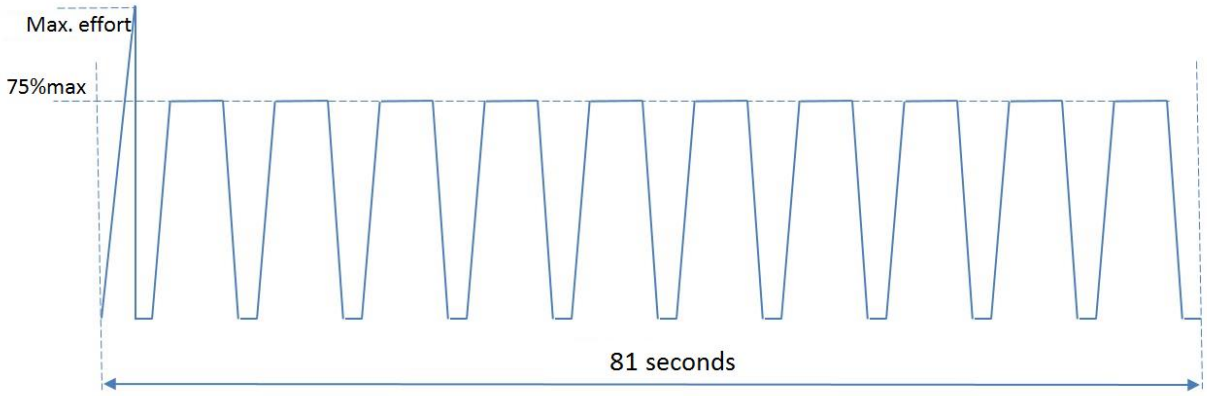

Fig. 3. Temporal characteristic of a single series of sample cycles

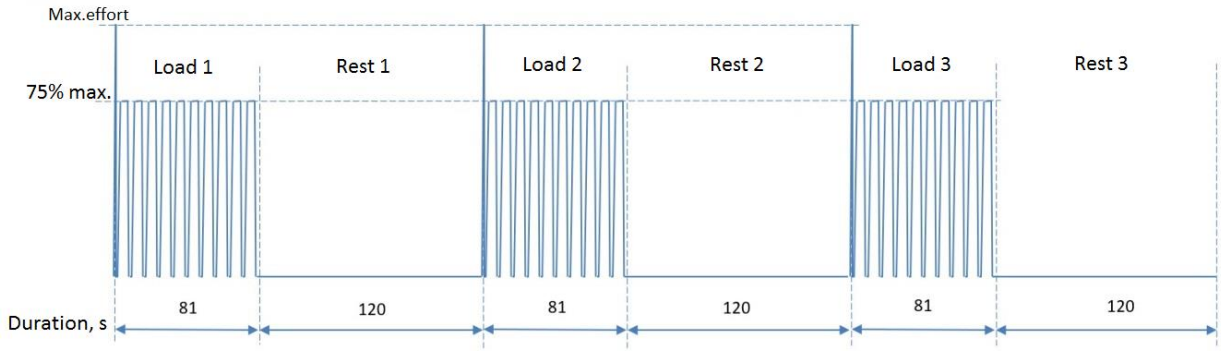

Fig. 4. Temporal characteristic of three series of sample cycles

Conclusion. The proposed dynamometric interval test is a tool for assessing the functional fitness of climbers, in particular their ability to tolerate repetitive loads on finger and forearm muscles. The test results contribute to the optimization of the training process by including effective ways of urgent recovery from neuromuscular fatigue. Parallel diagnosis of the

functional state of the central and autonomic nervous system, as well as a comprehensive assessment of the interrelationships of the parameters of these systems with the integral indicators of work capacity and competitive performance is advisable.

Conflict of interest. The author declares no conflict of interest.

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PSYCHOPHYSIOLOGICAL CHARACTERISTICS OF STUDENTS ENGAGED IN HIKING TAKING INTO ACCOUNT THE TYPOLOGICAL FEATURES OF HEART RATE VARIABILITY

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Abstract. The aim of the study was to determine the psychophysiological characteristics of students engaged in hiking during a weekend hike, taking into account the typological features of heart rate variability. In the conditions of the natural topography of Crimea, weekend hikes were conducted among male students of the main group aged 18-20 years (n=14), once a week, lasting 6 hours with a load in the power zone I (50-60% of heart rate). The experiment, lasting 20 weeks, included the ascertaining and control stages. Systematic physical activity with aerobic activity in the power zone I determines an increase in the functional state of the central nervous system. At the same time, the features of the psychophysiological characteristics of students are revealed depending on the prevailing type of autonomic regulation.

Keywords: heart rate variability, psychophysiological state, tourism, recreational activities, students.

Introduction. It is commonly known that study at university is closely associated with increased uptake of scientific information, which characterizes increasing psychoemotional stress among modern students. Meanwhile passive leisure (social media, computer games) cause reduced activity of the functional systems of the body, as well as adaptive reserves of the nervous, endocrine and immune systems [1-3]. In recent decade, a trend for poorer health among youth in the course of obtaining professional education was identified [4-6]. According to the sources, moderate physical activity in conditions of info deprivation and positive atmosphere is recommended for a person in a state of psychoemotional stress associated with sedentary lifestyle. Moreover, Tretyakova T.N. (2015) points out that recreational hiking is the best option in this case [7-11]. The relevance of this research is due to insufficient coverage of the issue on how consistent recreational hiking influences psychoemotional state of student youth [12], taking into account the type of autonomic regulation (AR).

Therefore, the aim of the study – to identify psychophysiological characteristics of students engaged in hiking during weekend hikes, taking into account the AR type.

Methods and organization. The study took place in the Sevastopol State University, involved male students of the main health group aged 18-20 years (n=14), engaged in hiking, during weekend hikes (WH). WH were carried out once a week, lasted for 6 hours with load in the power zone I (50-60% of heart rate), in conditions of the natural topography of Crimea. The experiment that lasted 20 weeks included two stages – the ascertaining (stage I) and control (stage II) stages. To achieve the objective, studies of the psychophysiological state of students were conducted with the NS-PsychoTest (Neurosoft LLC, Russia) complex and the Poly-Spectre.NET complex with the PolySpectre-8/EX recorder (Neurosoft LLC, Ivanovo, Russia). Electrocardiographic recording was carried out at the time interval from 9 to 12 o'clock, in the second standard lead, after 5 minutes of rest. The orthostatic test was used for 10 minutes as a functional activity. We also assessed the heart rate variability (HRV) indices [13]. The psychoemotional state was evaluated using the A. Goncharov's adaptation of the WAM method (wellbeing, activity, mood). The tapping test was applied to test strength of the nervous processes. According to the "Attention assessment" method, we also evaluated the body response stability (RS), functional state (FS) and functional capabilities (FC) of the body's systems. Balance of the nervous processes was estimated taking into account the probability of error occurrence in the entropy scale (En) and mean response time (MRT) according to the "Response to a moving object" method [14].

With the Statistica 6.0 package, we processed the accumulated database with identification of arithmetic mean (M) and standard error (m). The reliability of differences between the samples was identified with the Wilcoxon signed-rank test.

Results and discussion. The HRV analysis has revealed an optimal state of the regulatory systems in 33% of all the cases (type III) [13]. Moreover, moderate stress of the regulatory systems (type I) has been found in 8% of all the cases, while type II was not identified. A pronounced predominance of the autonomous AR circuit (type IV) has been revealed in 59% of all the cases, which determines the development of students' fatigue (fig. 1).

At the same time, the "significant" decrease in general performance according to the tapping test has been revealed for all the subjects at the ascertaining stage.

At the ascertaining stage, the WAM method analysis has found "unfavorable" psychoemotional state in the students with type I and IV, the students with type III had moderate psychoemotional stress [14]. The "Attention assessment" analysis has shown predominant strength of excitation processes in the text subjects with type IV, as well as more balanced nervous system in the test subjects with types I and III. The "Attention assessment" has revealed insufficient level in the test subjects with types I, III and IV. The response time was average.

It is widely recognized that hiking is a long-hour work of cyclic nature [15]. Consistent physical activity with aerobic load in the power zone I defines adaptive rearrangements connected with the tone activation of the parasympathetic division of the autonomic nervous system, which, in turn, has shown an improvement in the functional state of the central nervous system [16].

At the control stage, the HRV analysis has identified type IV in 27% of all the students, which is by 54.2% ($p \leq 0.05$) less in relation to the identified number of the subjects with type IV at the ascertaining stage (fig. 2).

In addition, 67% of all the cases had moderate predominance of the autonomous curve of AR, which is two times (103%, $p \leq 0.05$) more than it was at the stage I. Moreover, a number of those with moderate predominance of the central curve has increased insignificantly (25%, $p \leq 0.05$) compared to those at the stage I. No students with the predominance of the central curve were found at the control stage.

The analysis of data on the psycho-physiological state has revealed a moderate decrease of performance in the tapping test. Increased level of the functional state and functional capabilities has been determined in accordance with the Loskutova's criteria scale. Balanced variant of inhibition and excitation in the students with types I and II, as well as predominance of excitation in the students with type IV was defined according to the "Response to a moving object" method. According to the data provided by Mantrova I.N. (2007), occurrence of mental states is due to subjective significance for a person and duration of exposure to external factors [14]. Systematic WH contributed to an improvement of total score in the WAM scales. The students with type I and II have demonstrated "favorable" results, while the students with type IV had "moderate" psychoemotional state.

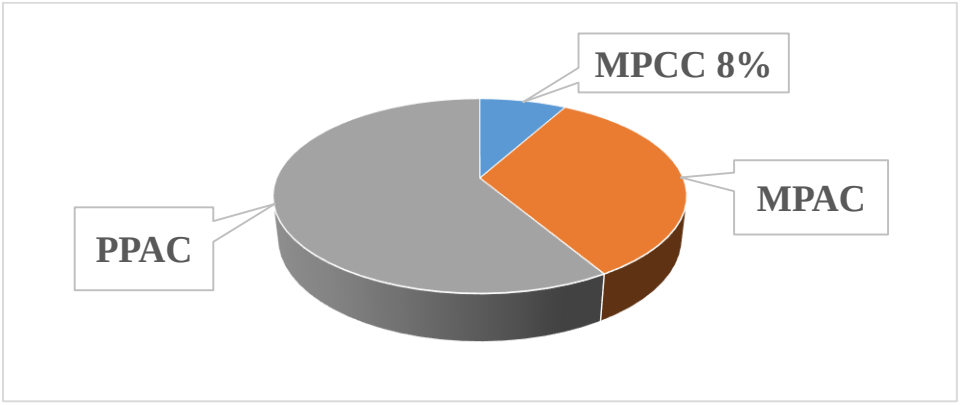

Fig. 1. Comparison of the AR type of students engaged in hiking at the ascertaining stage

Note: MPAC – moderate predominance of the autonomous curve of regulation; MPCC – moderate predominance of the central curve of regulation; PPAC – pronounced predominance of the autonomous curve of regulation.

Table

The psychophysiological state of the tests subjects taking into account the AR type at ascertaining and control stages

Method	Index	Stage	Type of autonomic regulation			
			I	II	III	IV
Response to a moving object	MRT, ms	I	-19.4±1.3	Not identified	-12±1.1	-55±7.8
		II	-10±0.09▲		-8±0.06*	-47±7.1•
	En, c.u.	I	2.63±0.09		2.05±0.07	3.41±1.3
		II	1.18±0.04		1.07±0.04	2.85±0.07
Attention assessment (criteria by Loskutova T.D.)	MRTV, ms	I	234.3±95.1		236.1±93.9	261.8±97.1
		II	218.7±87.8▲		194.6±81.3*	231.4±93.3•
	FS, c.u.	I	4.1±1.2		4.6±0.09	3.5±0.08
		II	4.4±1.1		4.9±1.1	4.3±1.3
	RS, c.u.	I	1.4±0.02		1.6±0.02	1.1±0.04
		II	2.2±0.03		2.2±0.01	1.8±0.05
	FC, c.u.	I	3.0±0.03		3.2±0.01	2.06±0.03
		II	3.6±0.04		3.8±0.03	3.0±0.02
WAM	Total score, points	I	3,7±0.21		4.8±0.27	3.3±0.19
		II	5.5±0.32▲▲		6.1±0.41**	4.6±0.24••

Note: I – the ascertaining stage; II – the control stage; type I – moderate predominance of the central curve of regulation; type II – pronounced predominance of the central curve of regulation; type III – moderate predominance of the autonomous curve of regulation; type IV – pronounced predominance of the autonomous curve of regulation; MRT (ms) – mean response time; En (c.u.) – entropy; FS (c.u.) – functional level of the system; RS (c.u.) – body response stability; FC (c.u.) – level of functional capabilities; MRTV (ms) – mean reaction time value; WAM (point) – wellbeing, activity, mood; * – reliability of differences, p≤0.05 of type III intragroup values, stage I and II; ** – reliability of differences, p≤0.01 of type III intragroup values, stage I and II; ● – reliability of differences, p≤0.05 of type IV intragroup values, stage I and II; ●● – reliability of differences, p≤0.01 of type IV intragroup values, stage I and II; ▲ – reliability of differences, p≤0.05 of type I intragroup values, stage I and II; ▲▲ – reliability of differences, p≤0.01 of type I intragroup values, stage I and II.

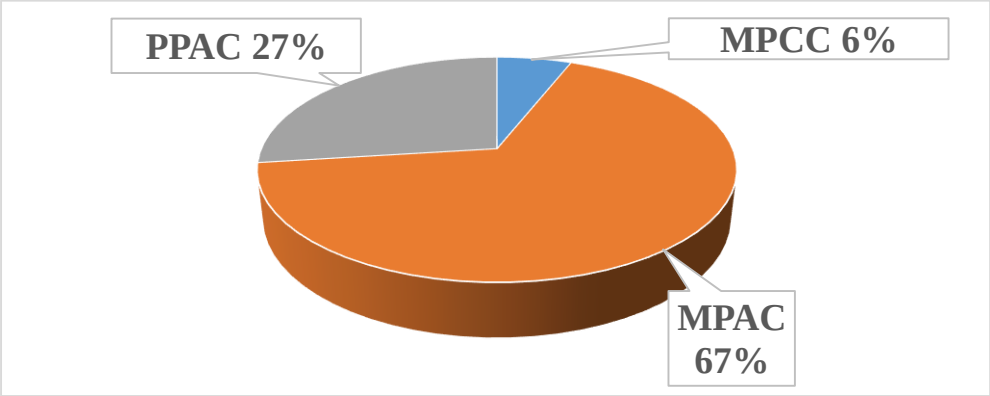

Fig. 2. Comparison of the AR type of students engaged in hiking at the control stage

Note: MPAC – moderate predominance of the autonomous curve of regulation; MPCC – moderate predominance of the central curve of regulation; PPAC – pronounced predominance of the autonomous curve of regulation.

Conclusion. Therefore, we have identified features of the psychophysiological state of students engaged in hiking, taking into account the predominant type of autonomic regulation. Recreational physical activity in a form of a weekend hike through the training effect of adaptive rearrangement of the body contributed to the improvement of the functional state of the central nervous system and an increase in the number of the students with a moderate predominance of the autonomous circuit of regulation.

Conflict of interest. The authors declare no conflict of interest.

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EFFECT OF DIFFERENT DOSES OF CAFFEINE ON SENSORIMOTOR REACTIONS IN FREESTYLE WRESTLERS: A PILOT CONTROLLED TRIAL

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Abstract. A wrestler's performance depends on the speed of situation assessment, decision making and reaction accuracy. Caffeine has established itself as an ergogenic agent capable of improving performance. The aim of the study was to evaluate the effect of different doses of caffeine supplement on the speed of sensorimotor reactions in freestyle wrestlers. Representatives of the Moscow men's freestyle wrestling team (n=7) took part in the study. In a double-blind crossover study, participants took a placebo, a high dose of caffeine (6 mg/kg body weight), a moderate dose of caffeine (3 mg/kg body weight) and a low dose of caffeine (1.5 mg/kg body weight) 45 minutes before testing (Schulte table, Simple Visual-Motor Reaction Test and Choice Reaction Test). The results of the pilot study suggest that caffeine supplementation at doses of 1.5 and 3 mg/kg body weight may have a positive effect on attention span, attention allocation, and choice reaction speed in freestyle wrestlers.
Keywords: caffeine, ergogenic aid, freestyle wrestling, dietary supplement, reaction speed, cognitive processes.

Introduction. Martial arts are popular in Russia and around the world for those engaged and from the point of social and entertaining significance [1, 2]. Thus, a level of competitiveness increases, which required additional methods, application of ergogenic aid in particular. Caffeine (1,3,7-trimethylxanthine) is recommended by different international sport communities as a pharmaconutrient improving physical and cognitive working capacity [3-5]. Two meta-analyses showed effectiveness of caffeine in martial arts [6, 7]. They examined working capacity indices among representatives of different martial arts (jujutsu, judo, taekwondo etc.), but less randomized controlled trials (RCTs) are aimed at studying the effect of caffeine on working capacity in wrestling. Wrestling competitions are held in different weight categories and styles. Success depends on a number of motor qualities, such as strength, speed, endurance, flexibility, technique and reaction. Reaction time is a time interval before the stimulus and the corresponding volitional response [8]. Among factors, which define performance of a wrestler, are an ability to assess the situation quickly, decision making and reaction accuracy [9]. Reducing the reaction time may potentially improve effectiveness of offensive and defensive movements and extrapolate the opponent's movements successfully. Aim of the study was set according to the problem survey: to evaluate influence of different doses of caffeine on speed of sensorimotor reactions in freestyle wrestlers.

Methods and organization. The study was carried out in the laboratory of the Center for Sports Innovative Technologies and National Team Training in cooperation with the Sport Medicine Department of the Russian University of Sport "GTSOLIFK". The study was conducted in accordance with CONSORT 2025 (Consolidated Standards of Reporting Trail) [10] (fig. 1).

All the participants gave an informed written consent for participation in accordance with the Ethical Standards in Sport and Exercise Science [11]. Before signing the consent, all the participants were informed about the study protocol. The study involved representatives of the Moscow men's national freestyle wrestling team. Initially, the sample included 13 people. The inclusion criteria were:

a) training experience of at least 6 years and more, as well as qualification not lower than the Candidate for Master of Sports;

b) CYP1A2 (cytochrome P450 1A2) gene variant – in order to participate, the athlete should have the "AC" genotype ("normal metabolizers"

[12]), since CYP1A2 variants define speed of caffeine metabolism [13];

c) no restrictions on sports activities. After exclusion from the initial sample, 7 athletes were included in the study. Participants competed in the 2024-2025 season and trained an average of 10 hours per week.

The body composition analysis was carried out with bioimpedance on the Medass ABS-02 analyzer (Medass, Russia) per the manufacturer's recommendations. Body mass (BM) was measured with the Seca769 weights (Seca, Germany), body length – with the Seca222 stadiometer (Seca, Germany).

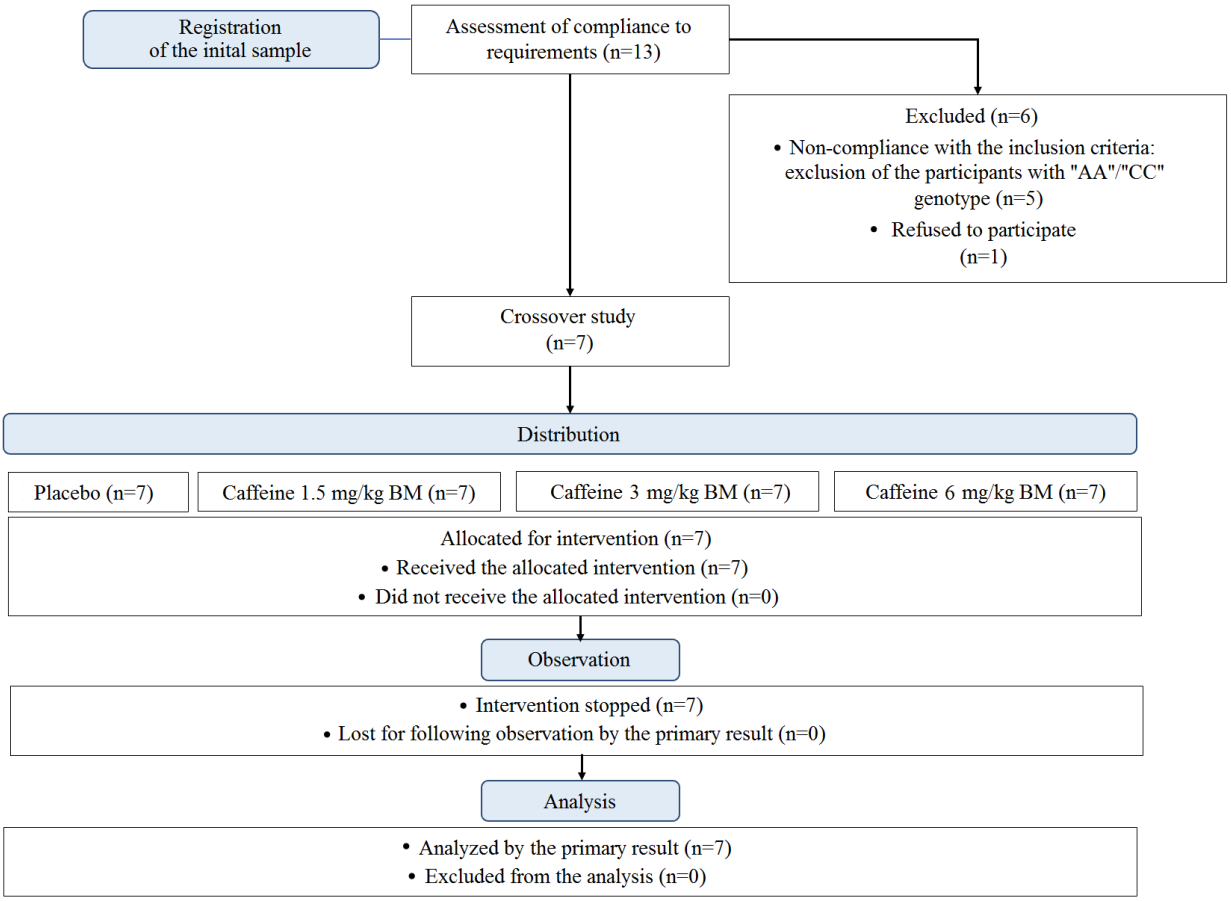

Fig. 1. The CONSORT flowchart

The anthropometric characteristics of the participants (the data are presented in a form of average ± standard deviation): body mass index (BMI) – 26.6±3.2 kg/m^2, body length (BL) – 177.4±4.7 cm, body mass (BM) – 83.7±8.5 kg, skeletal muscle mass (SMM) – 35.2±2.6 kg, body fat mass (BFM) – 21.6±3.9%. Average year of the participants – 23.4±3.4 years.

The participants lead a usual lifestyle in terms of diet, training and sleeping routine during the study. A day before testing, the participants restrained from intense physical activity. They were also prohibited from using any supplement a week before testing, as well as from food sources of caffeine (coffee, chocolate, carbonated drinks, etc.) one day before testing.

The study followed a crossover, double blind, placebo-controlled design. Participants and researchers were blinded. Prior to testing, participants visited the laboratory for CYP1A2 gene variant identification, anthropometric assessment, and introduction to the tests. In a double-blind method, participants took placebo, high dose of caffeine (6 mg/kg BM), moderate dose of caffeine (3 mg/kg BM) and low dose of caffeine (1.5 mg/kg BM) 45 minutes before testing, washed down with a glass of water [14]. The capsules contained anhydrous caffeine supplement (BeFirst, Russia) or maltodextrin (Bionova, Russia). The capsules were opaque white, the number of capsules provided to the athlete was always the same (3 capsules) regardless of the caffeine ingestion protocol.

Each test was conducted in the morning, the test subjects could adjust height of the chair and position of the armrests. The subjects were instructed not to use smartphones or other gadgets. Each of the tests was conducted three times, the best attempt was registered. Exposure to external stimuli (noise, bright light) was

minimized. A Dell E2424HS monitor (23.8 inches diagonal, 1920x1080 resolution (Dell Inc., USA)) was used.

First, the test subjects performed the Schulte table test – a square matrix with five columns and five rows, in which the numbers from 1 to 25 are placed in a random order. The subjects had the select the numbers in direct order (1 to 25) by clicking on the needed number. The test was performed at https://schultetable.ru/training/.

Then the test subjects performed the Choice Reaction Test, where the participant needed to wait on a signal (black cross) in one of four white squares (e.g., there are four different positions of the black cross, which are considered four different stimuli). Each signal corresponded to a key on the keyboard ('x', 'c', 'b', 'n') (fig. 2). Thus, there are four stimulus-reaction associations. The number of presented signals is 10. The test was performed at https://www.psytoolkit.org/lessons/simple_choice_rts.html.

Then the Simple Visual-Motor Reaction Test (SVMR) was performed with the NS-Psychotest complex (Neurosoft, Russia). The subjects were successively shown green light signals, at the appearance of which they were required to press the green button as quickly as possible, making least errors possible. Errors were considered to be: prematurely pressing the button and skipping the signal. The light signal was shown at random moment to exclude the possible formation of temporal reflexes. The intervals between signals were 0.5-2.5 s. The number of stimuli presented was 30.

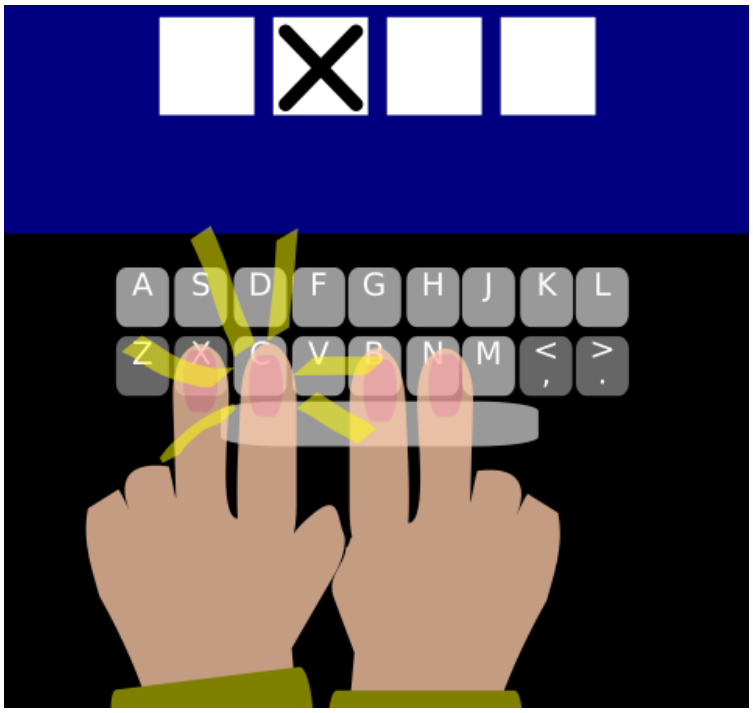

Fig. 2. Graphic depiction of the Choice Reaction Test. The participant needed to push the "c" button.

Genetic study. The genetic test was performed in the "Genomed" laboratory (Moscow). In the morning, on an empty stomach, a venous blood sample was taken from the ulnar vein and placed in a test tube with ethylenediaminetetraacetic acid.

Statistical analysis. The statistical analysis was done in STATISTICA 10 (StatSoft, USA). The Wilcoxon's signed rank test was used to compare different intake protocols between the caffeine supplement and placebo, as well as between different caffeine intake protocols. The results are presented in a form of median [1st quartile; 3rd quartile].

Results and discussion. According to the results from the Schulte table test, statistically significant differences were found in the reduction of table processing time when caffeine was administered at doses of 1.5 and 3 mg/kg BM, with differences found at a high level of statistical significance when caffeine was administered at 3 mg/kg BM. No statistically significant differences were found between caffeine doses (table 1).

However, none of the protocols of caffeine intake has not demonstrated statistically significant reduction of reaction time in the SVMR

test. There were no statistically significant differences between caffeine doses (table 2).

According to the results from the Choice Time test results, we have identified statistically significant differences in reducing reaction time when caffeine was administered at a dosage of 3 mg/kg BM. No statistically significant differences were found between caffeine doses (table 3).

Table 1

Schulte table results, Me [Q1; Q3]

Protocol	Result, s
Placebo	66 [51; 80]
Caffeine 1.5 mg/kg BM	59 [50; 77]*
Caffeine 3 mg/kg BM	59 [51; 71]**
Caffeine 6 mg/kg BM	65 [50; 76]

Note: * – statistically significant differences compared to placebo, $p<0.05$; ** – statistically significant differences compared to placebo, $p<0.01$; BM – body mass.

Table 2

Simple Visual-Motor Reaction test results, Me [Q1; Q3]

Protocol	Result, ms
Placebo	281 [198;314]
Caffeine 1.5 mg/kg BM	279 [201;341]
Caffeine 3 mg/kg BM	271 [194;323]
Caffeine 6 mg/kg BM	278 [195;336]

Note: * – statistically significant differences compared to placebo, $p<0.05$; BM – body mass.

Table 3

Choice Time test results (average reaction time) , Me [Q1; Q3]

Protocol	Result, ms
Placebo	440 [403;570]
Caffeine 1.5 mg/kg BM	440 [420;497]
Caffeine 3 mg/kg BM	415 [392;529]*
Caffeine 6 mg/kg BM	437 [410;561]

Note: * – statistically significant differences compared to placebo, $p<0.05$; BM – body mass.

No side effects were reported by the test subjects after supplement intake.

Effect of caffeine on cognitive functions were thoroughly examined before: it improves cognitive abilities in athletes [15] and military personnel [16], as well as technical and tactical skills in some martial arts [7]. As we know, it is a first placebo-controlled study, which examined effect of changes in caffeine doses on results in tests assessing speed of sensorimotor reactions in freestyle wrestlers. Our total results show that caffeine intake 45 minutes before testing at doses of 1.5 and 3 mg/kg BM may reduce reaction time in the Schulte table test and the Choice Reaction test. It should be noted that the results of RCTs evaluating the effect of caffeine on cognitive functions resulted in different experimental data, which may be related to individual features of caffeine "sensitivity" [17], which, apparently, is genetically determined [18]. Therefore, our study included only so-called "normal metabolizers" of caffeine [12]. [12].

Caffeine (1,3,7-trimethylxanthine) is a methylxanthine alkaloid that has been found to inhibit adenosine A1 and A2a receptors in the central nervous system and increase arousal and psychomotor activity [19]. At doses of ~300 mg (4 mg/kg BM), it improves working capacity with minimal side effects in a wide spectrum of cognitive functions, preventing decrease of vigilance and attention resulting from suboptimal arousal [20]. Interesting that in our pilot study, caffeine dosage of more than 3 mg/kg BM has not improved reaction time, and the participants reported no side effects.

Our results also demonstrate that the supplement intake at dosages of 1.5 and 3 mg/kg BM may have a positive effect on attention span, attention allocation, and choice reaction rate in freestyle wrestlers. Caffeine may be particularly useful under conditions of fatigue (during competition or high-intensity training) in reducing vigilance by improving the above parameters. In a similar context, the use of

caffeine may be beneficial for athletes who compete after flying across multiple time zones when their sleep is disrupted [19]. A forced reduction in BM (a reduction of 5% of initial BM or more) may lead to a decrease in reaction time in wrestlers [21]. In this case, caffeine administration may also be appropriate.

Conclusion. The results of our pilot study indicate that compared to placebo the caffeine supplement intake at doses of 1.5 and 3 mg/kg BM may positively influence attention span and allocation, choice reaction rate in freestyle wrestlers. Higher dosage of 6 kg/mg BM did not improve performance in any of the tests. In the SVMR test none of the caffeine dosage caused statistically significant reduction of reaction time. Caffeine intake may be effective for an increase of cognitive working capacity in freestyle wrestling. Additional RCTs on this topic are required.

Conflict of interest. The authors declare no conflict of interest.

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FUNCTIONAL STATUS OF THE MUSCULOSKELETAL SYSTEM AND PHYSICAL WORKING CAPACITY OF ASTRONAUTS COMPARED TO HEALTHY VOLUNTEERS

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Abstract. Microgravity in conditions of spaceflight has its own effects on almost all physiological systems of a human. The most vulnerable ones, which are of key importance, are the musculoskeletal, vestibular and nervous systems. Currently, there are many programs of sanatorium-resort treatment and health-improvement of these systems for different population groups. Thus, an issue occurs on how applicable the already existing restorative and therapeutic procedures and methods are in the post-flight rehabilitation of astronauts. Therefore, the aim of this work is a comparative analysis of functional features of the musculoskeletal system and physical working capacity of astronauts compared to healthy male volunteers. The study involved 7 male astronauts and 10 healthy male volunteers. The observation included densitometry, bioimpedance analysis, dynamometry of knee joint flexor and extensor muscles, and registration of physical working capacity on a bicycle ergometer. The results have shown that the mineral density of skeletal structures in the astronauts corresponds to the age norm. According to the bioimpedance analysis data, the fat component of body mass is slightly higher than the norm, and the muscle component of body mass is significantly lower than the norm, the strength indices of the right hand are lower than the norm as well. Low indices of maximum strength and power of the knee joint flexor and extensor muscles in the astronauts match with sufficient indices of strength endurance. The astronauts also had a high level of physical work capacity. The obtained data will be implemented in the development of the 2nd stage post-flight rehabilitation program for astronauts.

Keywords: astronauts, functional status, musculoskeletal system, muscle strength, physical working capacity.

Introduction. Zero gravity is a specific integral irritator affecting an astronaut's body during the whole orbital flight. It causes changes in a number of vital functions, including musculoskeletal, central nervous systems and receptors of many analyzing systems (vestibular and musculo-articular systems) [1-3]. At present, the general patterns of readjustment shifts in astronauts during the post-flight period are well known. They mainly center around a decrease in tolerance to physical activity and orthostatic effects, a significant muscle mass loss, and a complex of sensory and motor disorders [3-5].

The aforementioned defines significance and need to develop an effective program of the 2nd stage of post-flight rehabilitation (PR) of astronauts in sanatorium-resort conditions, the basis of which will include a creation of maximally favorable conditions contributing to a faster and more fulfilling restoration of the musculoskeletal system function, muscle strength and physical working capacity of astronauts [6-8]. At present, a large number of programs of sanatorium-resort treatment and recovery for various population groups have already been developed [9-10]. The question arises about the applicability of already existing developed restorative and therapeutic procedures and methods in the astronauts' PR program. In this regard, the aim of the work was a comparative analysis of functional features of the musculoskeletal apparatus and physical working capacity of astronauts compared to healthy male volunteers.

Methods and organization. The study was carried out in the North-Caucasian Federal Research-Clinical Center of Federal Medical and Biological Agency, the S.M. Kirov Sanatorium and the Orion Center for Athlete Recovery and Rehabilitation. The study included seven male astronauts (Me [Q1; Q3]): age – 55 [52; 57] years, height – 176 [172; 178] cm, weight – 89 [82; 102] kg, they were included in the main group (MG). The control group (CG) included

ten male volunteers leading an active lifestyle (coaches in different sports), age – 44.5 [42; 48] years.

All the participants gave an informed consent in accordance with the WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects (2013), as well as a permission for personal data processing. The study was approved by the Local Ethical Committee for Biomedical Research Expertise of the North-Caucasian Federal Research-Clinical Center of Federal Medical and Biological Agency.

Diagnostics of the total bone tissue density and structure, thickness of the superficial bone layer of the musculoskeletal system was carried out by means of densitometry (Hologic Inc., USA) using X-ray radiation. Body composition was determined in accordance with body resistance measurement in tetrapolar mode at a 50 kHz frequency on the ESTECK System Complex (LD Technology, USA).

Strength and static endurance of torso extensor muscles were measured using the DS-200 torso dynamometer (CJSC "Nizhny Tagil Medical Instrument Plant", Russia), maximal wrist strength – with the EH101 digital dynamometer (China). The study of strength indices of the knee joint flexor and extensor muscles was carried out with the CON-TREX biomechanical complex with biofeedback (MJ modules for muscles and ligaments of the lower limb joints and TP modules for torso muscles) (Physiomed, Germany).

To determine physical working capacity of the astronauts, we used the PWC 170 test on a bicycle ergometer. Calculation of physical working capacity was made with the Karpman's formula.

The statistical data processing was done in Statistica 13.0. We calculated standard descriptive statistics indicators (median, first and third quartiles). To develop the assessment criteria, we applied the quartile method.

Results and discussion. To identify the features of the functional state of the astronauts' musculoskeletal system and strength indicators, we measured the mineral density of skeletal structures, body mass composition, and strength characteristics of muscle groups using various specialized dynamometers.

At densitometry the values of t-test in all subjects were within the established norm (not higher than +2,5 SD and not lower than -1 SD) that testifies that the mineral density of skeleton structures corresponds to the age norm and there are no signs of osteoporosis.

The analysis of body composition indices of the astronauts according to the bioimpedance analysis data in comparison with the norms for healthy men revealed that the fat component of body mass was slightly higher than the norm and the muscle component of body mass was significantly lower than the norm (table 1).

The astronauts also had lower than normal (35-50) right hand strength – 28.6 [22.2; 34.5] kg. Left hand strength (38 [28.3; 38.2] kg) and back strength were within the norm (140 [128; 142] kg) for men of this age (the normal values are 30-40 kg and 130-150 kg respectively).

To assess the strength parameters of leg muscles, muscle strength was tested on the CON-TREX isokinetic dynamometer in male volunteers and astronauts. When developing norms in the estimation of indicators of dynamometric research of the knee joint muscular system of men, we registered the indicators of healthy men leading an active lifestyle. These indicators in the form of medians and quartiles are presented in the table 2. According to these data, even in healthy KG men, the performance of flexor and extensor muscles is very different, i.e. muscle performance is not balanced.

Table 1

Body composition of male astronauts according to the data from bioimpedance analysis, Me [Q1; Q3] (n=7)

Indicators	Value	Norm
Fat-free mass, kg	66.2 [65.4; 70.2]	-
Fat mass, kg	21.2 [20.3; 26]	-
Fat component of body mass, %	24.4%	15-24
Total body water, %	57.7 [54.2; 58.4]	52-62.2
Body mass index, c.u.	24.1 [22.6; 24.3]	23-25
Muscle mass, kg	28.4 [27.7; 31.9]	-
Muscle component of body mass, %	32.2%	39-48

Nevertheless, rather high indices of muscular strength were noted, and therefore, according to these indices, norms for assessing the strength of muscles surrounding the right and left knee joints were developed (tables 3 and 4). Comparison of astronauts' indices with the data of CG men revealed that astronauts lacked muscle strength of the muscles surrounding the knee joints, especially on the right side, as well as even stronger muscle imbalance than CG men. However, low values of maximal muscle strength and power in cosmonauts were combined with good values of power endurance.

Table 2

Dynamometry of the knee joint muscle system in the control group men, Me [Q1; Q3] (n=10)

Muscle groups	Torque max, Nm	Torque max average, Nm	Average power, W	Work – fatigue, J/s	Total work, J
Knee joint extensor muscles on the right	40.6 [30; 106.7]	33.6 [15.9; 58.2]	23.35 [15.2; 50.3]	0.06 [0.03; 0.27]	502.65 [300; 1325]
Knee joint flexor muscles on the right	42.8 [22.4; 67.4]	38.05 [14.3; 63.1]	22.65 [7.6; 41.8]	0.09 [0.02; 0.17]	624.75 [434; 972]
Knee joint extensor muscles on the left	51.9 [26.4; 100.6]	33.55 [10; 88.1]	21.2 [19.2; 50.3]	0.19 [0.13; 0.34]	497.45 [220; 1065]
Knee joint flexor muscles on the left	41.05 [22.7; 50.3]	38.95 [32; 48]	20.4 [14.4; 32.4]	0.11 [0.07; 0.18]	575.5 [421; 840.8]

Table 3

Dynamometry of the right knee joint muscle system in astronauts compared to volunteers

Indicators	Level (based on the control group)			Main group indicator	Level
	Low	Average	High		
Knee joint extensor muscles					
Torque max, Nm	<30	30-106.7	>106.7	21.1	low
Torque max average, Nm	<15.9	15.9-58.2	>58.2	5.5	low
Average power, W	<15.2	15,2-50.3	>50.3	7.4	low
Work – fatigue, J/s	<0.03	0.03-0.27	>0.27	0.15	average
Total work, J	<300	300-1325	>1325	171.4	low
Knee joint flexor muscles					
Torque max, Nm	<22.4	22.4-67.4	>67.4	24	average
Torque max average, Nm	<14.3	14.3-63.1	>63.1	20.3	average
Average power, W	<7.6	7.6-41.8	>41.8	11.1	average
Work – fatigue, J/s	<0.02	0.02-0.17	>0.17	0.03	average
Total work, J	<434	434-972	>972	284.3	low

Table 4

Dynamometry of the left knee joint muscle system in astronauts compared to volunteers

Indicators	Level (based on the control group)			Main group indicator	Level
	Low	Average	High		
Knee joint extensor muscles					
Torque max, Nm	<26.4	26.4-100.6	>100.6	104.8	high
Torque max average, Nm	<10	10-88.1	>88.1	34.1	average
Average power, W	<19.2	19.2-50.3	>50.3	16	low
Work – fatigue, J/s	<0.13	0.13-0.34	>0,34	0.38	high
Total work, J	<220	220-1065	>1065	420.7	average
Knee joint flexor muscles					
Torque max, Nm	<22.7	22.7-50.3	>50.3	50.2	average
Torque max average, Nm	<32	32-48	>48	24.5	low
Average power, W	<14.4	14.4-32.4	>32.4	13.9	low
Work – fatigue, J/s	<0.07	0.07-0.18	>0.18	0.01	low
Total work, J	<421	421-840.8	>840.8	361.5	low

The initial level of physical working capacity of the astronauts was determined with the PWC 170 test on a bicycle ergometer. The results have shown the value of 1607.5 [1564.5;

1677.0] kgm/min. According to the norms for men of this age this index is estimated as high (>1200), hence the astronauts had a high level of physical working capacity.

Conclusion. Thus, the functional state of the musculoskeletal system of the astronauts is characterized by sufficient bone tissue indices, a high level of physical working capacity, but a small muscular component of body mass and lower maximal strength capabilities, especially in the right limbs, compared to normal men. There is a strong imbalance in muscle development: the muscles of the left limbs are more developed, which indicates the need to apply and develop special recovery and rehabilitation measures to increase the functional capabilities of the astronauts' musculoskeletal system and optimize the balance of muscles of the left and right halves of the body.

The obtained data will be used in the development of the 2nd stage post-flight rehabilitation program for astronauts.

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INCREASING THE FUNCTIONAL INDEPENDENCE AND PSYCHOEMOTIONAL STATE OF PERSONS WITH SPINAL CORD INJURY IN THE COURSE OF PHYSICAL REHABILITATION

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Abstract. Objective of the study – to develop a physical rehabilitation method for improving functional independence and mental state of people with spinal cord injury. The study involved six male patients with spinal cord injury aged 30-40 years. Level of injury – chest area; motor disorders – incomplete paraplegia; rehabilitation period – restorative. The restorative period that lasted 3 months included following methods: morning hygienic gymnastics, therapeutic gymnastics, independent sessions, therapeutic massage, autogenic training, indoor games, mechanotherapy and special exercise. We have registered significant improvements in the indices of the Functional Independence Measure scale, the Functional assessment scale for patients with spinal cord injury, motor tests, the Recovery Locus of Control Scale, the State-Trait Anxiety Inventory, and the Wellbeing, Activity, Mood Scale.
Keywords: spinal cord injury, functional independence, physical rehabilitation, motor activity, psychoemotional state.

Introduction. Spinal cord injuries are one of the most important medical issues related to high incidence of the most severe structural and functional consequences, high level of disability, social and mental maladaptation and severe economic burden for those injured and their families. The vast majority of injured become disabled for a long time, and often for life [1-3]. In recent decades, due to urbanization and changes in lifestyle and labor activity, especially among residents of large cities, as well as a result of a large number of natural and man-made accidents, military conflicts and terrorist attacks, car and plane crashes, there has been an increase in the incidence of severe combine injuries. The above has also affected significant changes in characteristics of spinal cord injury: spine injuries have increasingly become complicated with the spinal cord and nerve root bruising or compression, a number of cervical spine injuries grows and the incidence of complete injuries is reduced [4].

Patients with spinal cord injury (SCI) are at risk of developing life-threatening secondary pathologies such as deep vein thrombosis, urinary tract infections, pressure ulcers, respiratory complications, etc. [5, 6] Moreover, patients with SCI are subjected for negative changes in psychoemotional and psychophysical terms, registered in 82,5% of cases [7, 8], which substantially reduces the rehabilitation potential. SCI and following immobility or limited motor activity entail the strongest mental stress, which without timely motor activation, including means of physical rehabilitation, serves as a source of personal maladaptation with its various manifestations, including in society [9-11]. Adequate and timely application of means and forms of physical rehabilitation would allow in varying degrees to alleviate negative signs of SCI, improve functional independence and psychoemotional state of the patients, which defines relevance of this study.

Objective: to develop a physical rehabilitation method for improving functional independence and mental state of patients with SCI.

Methods and organization. The study involved volunteers (n=6) with SCI in conditions of inpatient treatment during the restorative period. Inclusion criteria: gender – male; age – 30-40 years; level of injury – chest area; motor disorders – incomplete paraplegia; rehabilitation period – restorative.

The functional independence was assessed with the Functional Independence Measure (FIM, points) that allows estimating degree of independence and self-care [12]; with the Functional assessment scale for patients with spinal cord injury (VFM – Valutazione

Funzionale Mielolesi, points), developed for assessment of functional independence of a patient with SCI [12].

Functional state of the musculoskeletal system of the test subjects was investigated by the following motor tests: "Standing by a Swedish wall in knee pads" (s) and "Squatting by a Swedish wall in knee pads" (number of squats). The psychoemotional state was estimated with: the Recovery Locus of Control Scale (points), the State-Trait Anxiety Inventory (points), the Wellbeing, Activity, Mood Scale (WAM, points).

The data processing was carried out with the Statistica 13 software package. We also calculated the mean value (X), standard deviation (σ). The Shapiro-Wilk test was used to identify the normalcy of distribution, the reliability of changes in the studied indices before and after the course was identified with the Wilcoxon's signed-rank test, $p \leq 0.05$.

Results and discussion. To improve functional independence of patients with SCI during the restorative period that lasted for 3 months, we applied the following forms of physical rehabilitation (PR): morning hygienic gymnastics (daily, 5-7 to 15 minutes), therapeutic gymnastics (daily, 5-7 to 30 minutes), independent sesisions (individual, small groups – daily, 2 times for 10-15 minutes), therapeutic massage (5 days a week for 15 minutes), autogenic training (daily for 5-10 minutes), indoor games (indoor badminton in particular – 3 times a week for 10-15 minutes), mechanotherapy (MOTOmed, Imitron, KORVIT – daily, 10 to 30 minutes). The special exercises included: active-passive exercises; resistance exercises; strength exercises; isometric exercises; exercises with equipment; balance exercises; exercises with autogenic training elements; relaxing, stretching exercises; exercises with game elements. The following initial positions were used (IP): supine, prone, sitting on a floor, genucubital position, crawling position; sitting and moving in a wheelchair. At the beginning of the course, the active-passive exercises were performed with the instructor's help combined with ideomotor training.

The FIM study has allowed to identify degree of independence and self-care of the studied group. Before the course, the average score was 62.83±7.63 points, showing average degree of independence and self-care. After the course, an increase by 34.2% to 84.33±4.03 points has been registered, which corresponds with the higher than average degree of independence and self-care.

The VFM study has allowed to identify a complex level of the functional state of the studied group (table).

Table

Changes in the indices of the Functional assessment scale for patients with spinal cord injury during physical rehabilitation, points, X±σ

Indices (subscales) / Physical rehabilitation stages	Bed mobility	Eating	Wheelchair use	Dressing	Moving	Mobility	Grooming	Social skills
Initial	12.17± 2.32	28.17± 1.17	25.67± 1.97	1050± 1.52	16.67± 1.37	4.0± 0.01	12.83± 0.75	39.50± 0.55
Final	22.0± 1.26	29.17± 1.17	35.50± 1.52	31.83± 2.93	33.00± 1.55	5.00± 0.89	27.17± 0.75	41.00± 0.01
P	≤0.05	≥0.05	≤0.05	≤0.05	≤0.05	≥0.05	≤0.05	≤0.05

The indicators have increased in the most VFM subscales (≤0.05) after application of the developed PR program. The most significant effect was achieved in the following parameters: the "Bed mobility" subscale has improved by 80.8%, from 12.17±2.32 to 22±1,26 points, i.e. from average to high level of proficiency of this motor skill; the "Dressing" subscale has improved by 203.1%, from 10.50±1.52 points to 31.83±2.93 points, i.e. from low to high level of proficiency; the "Moving" subscale has improved by 98.0%, from 16.67±1.37 to

33.00±1.55 points, i.e. from low to average level of proficiency; the "Grooming" subscale has improved by 111.8%, from 12.83±0.075 to 27.17±0.75 points, from low to higher than average level of proficiency.

In the "Wheelchair use" and "Social skills" subscales, we have also registered positive changes ($p \leq 0.05$) by 38.3% and 3.8% respectively. Changes in the "Wheelchair use" subscale were from 25.67±1.97 to 35.50±1.52 points. Dynamics in the "Social skills" subscale has improved from 39.50±0.55 to 41.00±0.01 points. At the same time, the values of the data obtained remained in the range of the average level before and after completing the PR course.

Positive changes of the "Eating" and "Mobility" subscales, observed with unreliable shifts (≥ 0.05) was 3.6% and 25.0% and improved from 28.17±1.17 to 29.17±1.17 points and from 4.00±0.01 to 5.00±0.89 points respectively. The unreliability of shifts in the "Eating" subscale is due to the fact that the level of proficiency in the skills assessed in this subscale was already high in the study population at the beginning of the program, with the average value close to the maximum possible. The unreliability of shifts in the "Mobility" subscale is due to the fact that in the specified recovery period, significant changes in mastering the skills included in this subscale were not expected in the chosen group, in accordance with the clinical picture. The results obtained indicate an expansion of the possibilities of movement and self-care for people with SCI.

Adaptation to verticalization of patients with SCI is mainly due to the functional state of the musculoskeletal system, which allows the subjects to take and hold vertical position with external support from the position of sitting in a wheelchair. In realization of the developed PR method, motor test indices have ($p \leq 0.05$) significantly improved. In the "Standing by a Swedish wall in knee pads" test, the average time has increased by 342.7%, from 23.00±8.51 s to 101.83±34.72 s. In the "Standing by a Swedish wall in knee pads" test, the average number of squats has increased by 179.9%, from 4.17±2.14 to 11.67±2.16 times. The obtained results ($p \leq 0.05$) reflect improvements in the musculoskeletal system's functional state and adaptation to verticalization of patients with SCI.

Results of the Recovery Locus of Control Scale (points) allowed making conclusions on the level of motivation of the subjects to recovery during the course. Before PR, the index amounted to 20.83±2.14, reflecting average level of motivation of the subjects to improve their health. After the course, the index has increased by 60.0% and amounted to 33.33±1.51, corresponding with high level of motivation. The observed positive changes shows improvements in motivation of the studied group to recover.

The State-Trait Anxiety Inventory study results have shown signs of anxiety as a trait, as well as the state of the subjects as a response to the current situation. According to the "State anxiety" and "Trait anxiety" scales, positive changes ($p \leq 0.05$) have been registered by 16.0 and 14.4% respectively. The dynamics of the "State anxiety: scale ranged from 58.50±3.21 to 49.17±2.71 points. The dynamics of the "Trait anxiety" scale improved from 56.67±3.27 points to 48.50±3.62 points. At the same time, the values of the data obtained remained in the range of high anxiety levels before and after completing the course.

The WAM scale study has assessed total psychoemotional state of the test subjects. The average scores on the WAM scale before the experiment were 30.33±4.50, 39.17±4.22 and 36.83±2.93 points, respectively, i.e. they were below the level of favorable psychoemotional state. After the course, the indicators on the "Wellbeing" scale increased by 55.0%, on the "Activity" scale – by 37.4%, on the "Mood" scale – by 23.1% and amounted to 47.00 ±2.83, 53.83±1.17 and 45.33 ±4.18 points respectively, demonstrating a significant improvement in the psychoemotional state of people with SCI.

Conclusion. Application of the developed PR method for people with SCI has contributed to an improvement of functional independence and psychoemotional state. We have registered positive changes in the indices of the Functional Independence Measure scale, the Functional Assessment Scale for Patients with SCI, motor tests, the Recovery Locus of Control Scale, the State-Trait Anxiety Inventory, and the Wellbeing, Activity, Mood Scale.

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CORRECTION OF HIP JOINT FUNCTIONALITY IN INFANTS WITH DYSPLASIA BY MEANS OF PHYSICAL REHABILITATION

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Abstract. The article considers the correction of hip joint functionality in infants with dysplasia using physical rehabilitation means. The course of application of physical rehabilitation means aimed at restoring hip joint functionality in infants with dysplasia took 11 weeks. The following were used: therapeutic exercises focused on the use of reflex, passive, active and developmental exercises in accordance with age, massage, hydrokinesitherapy, physiotherapy (laser therapy, electrophoresis). The effects of hip joint correction in infants with dysplasia are represented by reliable improvements in the studied parameters: the range of motion during adduction in the hip joint increased by 19.9% according to goniometry; pain according to the Face, Legs, Activity, Cry, Consolability scale decreased by 43.8%; fold asymmetry decreased by 45%; hip shortening was leveled by 44%; the manifestations of Ortolani and Barlow symptoms decreased by 37.5% and 33.3%, respectively. The results obtained reflected the positive dynamics of correction of hip joint functionality in infants with dysplasia using physical rehabilitation means.

Keywords: hip dysplasia, infants, physical rehabilitation equipment.

Introduction. The congenital diseases of the musculoskeletal system take the first place [1], 17% of them are lower limb defects: congenital hip joints, deformities of the lower limbs, valgus or varus, cliches, hip dislocations or subluxations, limb contraction [2].

One of the most frequent ones is congenital hip subluxation, hip dislocation and delay in the formation of hip joints in children in the first year of life, as well as, recurrences of musculoskeletal pathologies. Hip dysplasia is widespread among congenital pathologies of the muscular system in the first year of life. According to various sources, children have such pathology ranging from 2 to 16 cases per 1000 newborns, there are other data saying that the pathology occurs ranging from 1 to 3 cases per 1000 births [3, 4].

Congenital hip dysplasia is a serious disease. According to the statistical data from scientific literature, the development of deforming coxarthrosis occurs with a frequency of up to 82% after conservative and surgical treatment of this pathology with the possibility of disability up to 64% of patients, which confirms the need to search for new methods of rehabilitation of this pathology. In environmentally unfavorable regions there is a tendency of increasing incidence of this disease [5].

According to the data from domestic and foreign orthopedics and family doctors, successes in treatment occur due to early screening of newborns and early diagnosis, timely individually selected comprehensive treatment in the first 2-3 months of a child's birth from 70% to 97% of cases [6-8].

Long-term experience of scientists indicates the effectiveness of physical therapy, hydrokinesotherapy, massage and physiotherapy in rehabilitation of children with hip dysplasia [9-11]. Methodologically competent rehabilitation measures allow correcting functional disorders, which makes an issue of searching for a proper combination of ways and methods of physical rehabilitation (PR) of hip dysplasia relevant.

Objective of the study: assessment of the effects of correcting hip joint functionality in infants with dysplasia by using PR means.

Methods and organization. The study took place in the Children's Polyclinic of the Vidnoe District Clinical Hospital (Vidnoe, Moscow Oblast). The observation involved 14 children aged 6-8 months. Inclusion criteria: confirmed diagnosis of moderate hip dysplasia, age – 6-8 months.

Hip joint functionality was estimated according to the goniometry data (degrees) in hip adduction, in fold asymmetry assessment (points), in hip shortening assessment (points), according to the Ortolani (points) and Barlow

(points) symptoms, in assessing pain according to the FLACC (Face, Legs, Activity, Cry, Consolability) scale (points). The data processing was carried out with math-and-stats methods. We calculated the arithmetic mean, standard deviation. The reliability of changes in the results was assessed with the Wilcoxon's signed rank test ($p \leq 0.05$). All calculations were made in Microsoft Excel.

The PR course aimed to correct hip joint functionality in infants with dysplasia took 11 weeks. We used the following methods: therapeutic exercises focused on the use of reflex, passive, active and developmental exercises in accordance with age (daily), massage (daily), hydrokinesitherapy (3 times a week), physiotherapy (laser therapy, electrophoresis, not less than 15-20 procedures).

Results and discussion. Correction of hip joint functionality in infants with dysplasia has reflected in reliable positive dynamics of the studied indicators (table).

Table

Changes in the indicators of hip joint functionality in infants with dysplasia by using physical rehabilitation methods

Indicators	Stages		Growth rates, %	P≤
	Before	After		
Goniometry (hip adduction), degrees	140.40±4.77	168.30±3.83	19.9	0.05
Pain assessment according to the FLACC scale, points	5.70±0.82	3.20±0.79	43.8	0.05
Fold asymmetry assessment, points	2.00±0.00	1.10±0.32	45	0.05
Hip shortening, points	1.80±0.42	1.00±0.00	44	0.05
Ortolani symptoms assessment, points	1.60±0.52	1.00±0.00	37.5	0.05
Barlow symptoms assessment, points	1.80±0.42	1.20±0.42	33.3	0.05

Note: FLACC – Face, Legs, Activity, Cry, Consolability.

There is a significant improvement in the movement amplitude in hip joints by 19.9%, from 140.40±4.77 to 168.30±3.83 degrees.

Pain was estimated according to the FLACC scale – it is a behavioral scale for pain assessment used for infants and children up to 7 years of age that takes into account the child's facial expression, legs position or mobility, crying pattern, and the child's ability to be consoled. Before the PR course, pain in infants with dysplasia was rated at 5.70±0.82 points. After PR, it decreased by 43.8% and amounted to 3.20±0.79 points.

Correction of hip joint functionality in infants with dysplasia was reflected in the leveling of fold asymmetry by 45% and hip shortening by 44% from 1.80±0.42 points to 1.00±0.00 points. There was an improvement in hip congruency assessed by Ortholani and Barlow symptoms by 37.5% and 33.3%, respectively.

Conclusion. The effects of hip joint functionality in infants with dysplasia reflected in reliable improvements of the studied indicators: increased movement amplitude in hip adduction, reduced pain, leveled fold asymmetry and hip shortening, improved hip congruency assessed by Ortholani and Barlow symptoms. The obtained results have shown positive changes in correction of hip joint functionality in infants with dysplasia using PR means.

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A RETROSPECTIVE ANALYSIS OF ATHLETIC PERFORMANCE OF RUSSIAN SPEED SKATERS IN 2017-2024

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Abstract. The article presents a comparative analysis of the competitive performance of Russian skaters at the Russian championships and foreign skaters at the World Championships in the period from 2017 to 2024 based on the results of the official protocols. The COVID-19 pandemic has had an equally negative impact on the athletic performance of both Russian and foreign athletes. The suspension of Russian athletes from international competitions had a negative impact on the results of the Russian championships and a positive impact on the results of the World Championships. The increase in the athletic performance of foreign athletes at the 2024 World Championships relative to the results of the 2017 performance is 2.3% higher than that of Russian athletes at the Russian championships.
Keywords: speed skating, athletic performance, COVID-19 pandemic, suspension of Russian athletes.

Introduction. In modern history of the Russian sport and sport in whole, two global challenges took place: the COVID-19 pandemic and [1] and suspension of athletes from international arena [2-4]. Their overcoming required non-standard solutions in planning and conducting the training process. Suspension from international competitions has severely affected performance of Russian athletes. The lack of competition from the strongest foreign athletes has staggered progress and motivation among the top, established leaders in Russian sport [3, 5, 6]. Consequently, it had led to a generational change in Russian sport.

One of the most spectacular and popular winter sports is speed skating [7]. Speed skating is usually accompanied by over-the-limit physical activity and high speed that reaches its maximum [8, 9]. The main ways to achieve the highest results in speed skating are improving physical and technical fitness of athletes, using new generation skates to increase running speed, a constant improvement of the training process arrangement, psychological and medical support at all stages of preparation to competitions [10]. All the aforementioned points guarantee achievement of the highest results. The most objective criteria for training process evaluation is progress in athletic achievements, although it can be estimated only after the main season competitions [11]. Analyzing the results of athletes' performances at Russian and international competitions in recent years would allow us to assess the dynamics of the level of sportsmanship of Russian and foreign speed skaters.

Objective of the study – to examine changes in competitive performance of Russian and foreign speed skaters in 2017-2024.

Methods and organization. We have analyzed results of the official protocols from the Russian (RCs) and World championships (WCs). The changes were assessed in relation to the competitive results shown by athletes at the RCs and WCs in 2017. The results of the 2018 and 2022 RCs were excluded from the analysis due to the absence of WCs in this period.

To estimate dynamics of performance of Russian and foreign athletes, we used the following indices:

1. The average value of the results of the skaters who took the first 10 places at the competition (hereinafter X_{top}) was calculated according to the formula:

$$X_{top} = \Sigma i_1, i_2, i_n / n, \quad (1)$$

where i_1, i_2, i_n – individual results of top ten athletes at WCs or RCs, n – number of athletes.

The results of Russian athletes were excluded for the calculation of X_{top} for the 2017 WC, 2019 WC and 2021 WC.

2. Change in athletic results (P) at a certain distance was calculated relative to the result

obtained in 2017, according to the following formula:

$$P = -(X_{topY} - X_{top2017})/X_{top2017}*100, \quad (2)$$

where $X_{top2017}$ – average value of the results of top 10 skaters at 2017 WC и 2017 RC;

X_{topY} – average value of the sports result at RCs and WCs in 2019, 2020, 2021, 2023 and 2024 respectively.

Results and discussion. In the analysis of competitive performance of athletes at RCs and WCs, we have examined dynamics of the P indicator in 2019-2024 relative to the results of RCs and WCs from 2017.

Changes in athletic results in the Russia men's national team at RCs are presented in table 1.

Table 1

Changes in athletic results in the Russia men's national team according to the results from the Russian Championships, %

Distance/Year	2019	2020	2021	2023	2024
500 m	0.87	1.09	-0.62	-0.31	0.62
1000 m	0.82	0.64	-0.59	-1.02	0.18
1500 m	1.22	0.72	-0.43	-1.31	-1.14
5000 m	2.60	3.55	2.69	-0.74	-0.02
Average	1.38	1.50	0.26	-0.85	-0.09

In the period before the pandemic, the Russia men's national speed skating team had an improvement in athletic performance at all distances in the 2019 and 2020 seasons compared to our selected reference point (2017 results) by 1.38% and 1.50 % respectively (table 1). After the COVID-19 lockdown [4, 12, 13], athletes' performance reduced significantly but was above the results of the reference point. The P value averaged 0.26%. The results of the 2023 and 2024 sports seasons have a negative trend compared to the reference point and previous seasons. The changes in athletic performance in these seasons amounted to -0.85% and -0.09% respectively. Such changes may be related to the suspension from international competitions, loss of motivation of the team leaders and, accordingly, rejuvenation of the squad for the future. If we take into account the results of the 2024 sports season, we can see a positive trend of the P indicator in all the disciplines.

In the Russia women's national speed skating team, multidirectional changes in sports results were registered, which are presented in table 2.

Table 2

Changes in sports results in the Russia women's national team according to the results from the Russian Championships, %

Distance/Year	2019	2020	2021	2023	2024
500 m	-0.23	0.51	-0.97	-1.07	-0.03
1000 m	-1.25	0.19	-2.67	-2.19	-1.47
1500 m	-1.34	-0.42	-2.16	-2.66	-2.05
5000 m	0.98	0.74	-0.83	-4.24	-2.79
Average	-0.46	0.26	-1.66	-2.54	-1.59

Athletic performance in women's disciplines in the 2019 sport season decreased by 0.46% on average in comparison to the reference point (table 2). Female athlete performance increased by 0.26% in the 2020 season followed by a decrease to -1.66% in 2021 compared to the 2017 season. In the 2023 and 2024 sports seasons, a similar upward trend in performance with the men's team was registered. Thus, the analysis of the changes in athletic performance has demonstrated the negative impact of the pandemic and suspension both in men's and women's speed skating disciplines.

To assess changes in athletic performance of Russian athletes, a comparative analysis of the P indicator between the results of Russian athletes at the RCs and the results of foreign athletes at the WCs was carried out.

The P indicator changes in 2019-2024 have similar wave structure for both Russian skaters at the RCs and foreign athletes at the WCs. The data are presented in the figure below.

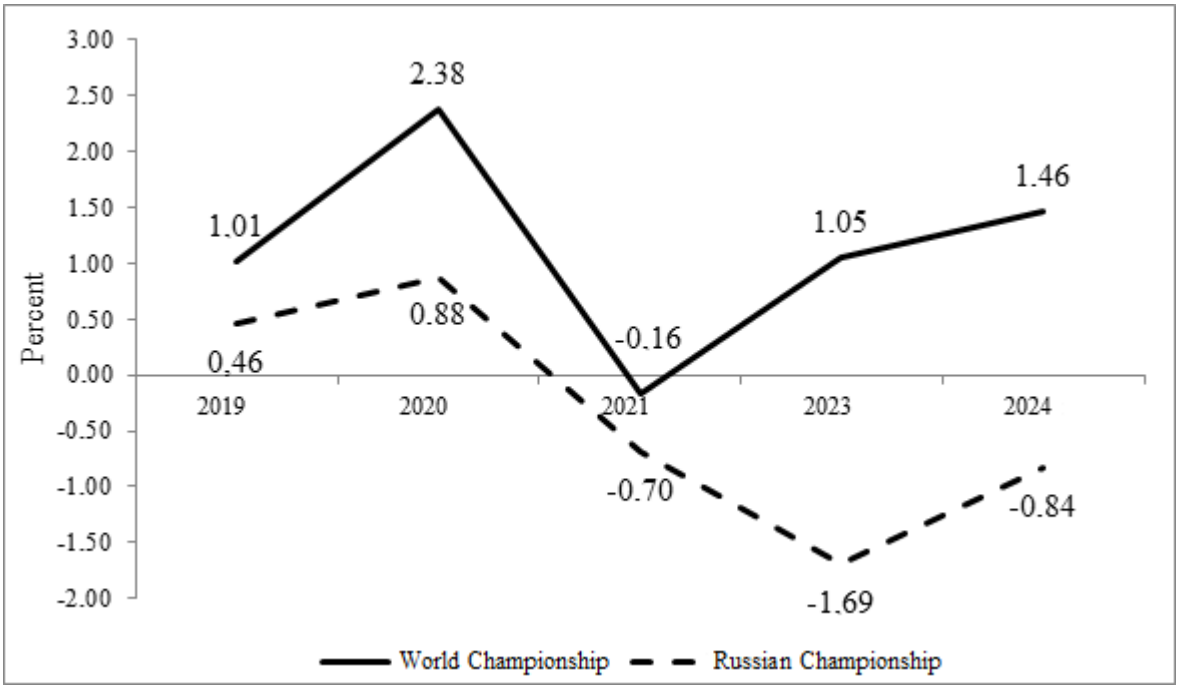

Fig. Changes in sports results of speed skaters at all distances at World and Russian Championships, %

Before the pandemic, an increase in the P indicator in the 2020 sports season is observed in both Russian and foreign athletes. After COVID-19, the level of athletes' performance decreased sharply. A negative trend is observed for both foreign and Russian skaters. The P indicator of Russian athletes amounted to -0.70% and to -0.16% for foreign athletes. After participation in the 2022 Winter Olympics and subsequent suspension from international competitions, Russian athletes show a further decrease in performance to -1.69%, while for foreign athletes this indicator increased to 1.05%. Thus, the suspension that followed almost immediately after the pandemic aggravated the level of athletic performance of Russian athletes and simultaneously improved the situation for foreign skaters. The changes of the P indicator by 2024 (fig.) show that Russian skaters managed to overcome the influence of unfavorable "challenges", and athletic performance has improved from -1.69% to -0.84%.

Conclusion. Analyzing the performance of speed skaters between 2017 and 2024 has revealed significant changes in world sport. Skaters' performance has been particularly affected by the COVID-19 pandemic and suspensions.

The COVID-19 pandemic has contributed to the preparation of athletes around the world. The 'Post-pandemic' sports season in 2021 is characterized by a decline in performance of both Russian and foreign athletes.

The suspension of Russian athletes from international competitions in 2022 exacerbated the negative impact of the pandemic on athletic performance of our athletes and, at the same time, led to an improvement in athletic performance of foreign athletes at WCs. The difference between the changes in athletic performance was 2.3% in the 2024 sports season relative to 2017. The decline in the sports performance of Russian athletes at RCs is due to the lack of competition from the strongest foreign athletes, which staggered the progress and motivation of the top, established leaders in Russian sport [3, 5, 6]. In the end, this led to a change of generations of skaters in the sport and an increase in athletic performance of Russian athletes by 2024.

Conflict of interest. The authors declare no conflict of interest.

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DEFINITIVE CLUSTER "PHYSICAL CULTURE": SEMANTIC STRUCTURE FROM THE GENERIC CONCEPT "CULTURE" TO THE SPECIFIC CONCEPT "HEALTH"

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Abstract. The article presents the results of theoretical research devoted to the problem of the categorical and conceptual framework development of the physical culture theory (a system of concepts reproducing different sides (meaning, significance, structure, etc.) of the object studied by science) from the positions of philosophical anthropology, culturology, semantics and linguistics. Aim of the study: theoretical justification of a new interpretation of the main definitions of the physical culture theory's categorical and conceptual framework in the light of recent research based on semantic analysis. The study uses methods of theoretical analysis, generalization and synthesis of published online scientific research in the field of pedagogy and physical culture theory. The keyword combinations built on the basis of semantic interrelations and semantic ranks allowed us to identify the definitive cluster (a set of terms united by a generic concept) of the concept "physical culture" as "cultivation of human nature with the aim of its improvement" and to present it by the following chain of combined terms: physical culture → motor culture → nutrition culture → body culture → health culture. Consequently, from the culturological and anthropological positions, "personal physical culture" as an integrative concept is a set of cognitive, motor, gastronomic (or nutritional), corporeal and valeological values that provide homeostasis of an individual (and, therefore, the human population as a whole) in the relevant for a particular cultural and historical stage of society development in its inherent natural and socio-environmental conditions. Due to the newly discovered scientific knowledge and research approaches in philosophical anthropology, pedagogy and sociology of personal physical culture, the process of the categorical and conceptual framework formation of the physical culture theory cannot be static, it is dynamic. Consequently, it allows and requires from the modern scientific community to timely adjust the basic terms interpretation and concepts according to the semantic canons relevant for a particular historical period, allowing more realistically reflect the connection of subject matter and the term, word combination or thesis representing it.

Keywords*:* physical culture theory, scientific knowledge, terms, definitions, semantics.

Introduction. At the current stage of society development in conditions of modern creative and pedagogical civilization, where a shift in educational paradigm occurs (direction towards a highly educated and self-sufficient person), a primary goal of education is the formation of a versatile, harmonious and free personality as a carrier of fundamental cultural values, including physical culture. However, to date, the issues of achieving a stable semantic standard (or benchmark) [1-6] in the categorical and conceptual framework (a system of concepts that reproduce different aspects (meaning, significance, definition, connection, structure) of the object studied by science) of the physical culture theory (PCT) remain controversial, which confirms the lack of validity of the identification, semantic, theoretical and conceptual framework in this field [7-21].

A constant consideration of the issue of PCT's categorical and conceptual framework in the history of scientific pedagogical knowledge development (since the main field for implementing physical culture methods is pedagogy) is accompanied by a number of controversial opinions (their points of connection, crossing, discrepancies) [12, 14], which indicates incomplete semantic process of forming basic definitions and their interrelation in definitive clusters (a system of concepts united by a semantic link) of scientific knowledge on physical culture or culture of a human nature ("physics" comes from the ancient Greek "φύσις" – "nature" and "φυσική" – "natural"). The fact that up to this moment the scientific society has offered and is successfully using more than 200 interpretations of the term "physical culture" adds to that [8, 12, 22]. This is due to the ever-expanding variety of "colors, tones, semitones and shades" in the PCT's scientific palette in the light of new research approaches, which initiates a forced retreat from the classical interpretation of basic terms, concepts and theses [10]. However, there is a

danger of institutional and culturological aberrations leading to a further distortion of initially accepted as a basis and non-compliable to semantic canons universal and unique scientific definitions [10, 23].

In the history of science, there is a vast number of such phenomenon's examples. The most eloquent of them is the case known since antiquity, when the ancient Greek astronomer Ptolemy repeatedly tried to substantiate the theory of the geocentric (with the planet Earth in the center) planetary system's multilevel structure. Since the theory was wrong from the start, as scientific research progressed, it required more and more additional explanations, corrections and alterations connected with the observed orbits of planets and the Sun's movement, up until the Copernican's heliocentric theory of the solar system (with the Sun at the center) was adopted , which put everything in its place. In our case, by taking as a starting point the generic notion of "culture" and its derived generic notion of "physical" in their original semantic meaning (from primary sources), we can convey to the general public at a more popular level a true understanding of the deeper meaning of the term "physical culture", while the vast majority of ordinary people (and often specialists) associate it with "sports" and "motor activity".

In our opinion, a way to solve the current issue of categorical and definitive diversity is a return to the beginning (the source or relict source material) origin of the term "physical culture" and consequent interpretation, related main concepts in the PCT's scientific knowledge according to semantics in terms of anthropology (the branch of science that studies the origin and development of human beings in the process of interaction with natural and cultural environment), since the term "physical culture" is mainly used in relation to humans, excluding all other forms of the Earth's flora and fauna. Consequently, from the positions of philosophical anthropology and cultural studies, in the centre of our semantic system 'physical culture' should be such semantic category as 'personality', which is a civilization embodiment of cognitive, spiritual, motor and corporeal values of a human.

From nature, a human receives their physical body as a unique high-tech and ready for development biological material (or template) for self-creation in direct interaction with the surrounding biogeosociocenosis (biological, geographic, climatic and social conditions of the environment). Since birth, some get a more or less effective one, but in whole, due to adaptive mechanisms, subject for exposure of education or self-education (creation of purposeful influence of external conditions for human development and self-development, mastering social experience, culture, values and norms of the community interacting with them). The template's result depends on a person themselves and their environment, as well as depth of their interaction. It is noteworthy that by improving their body thanks to adaptive mechanisms (first of all, its motor and cognitive functions), a person acquires, in the process of expanding their motor and intellectual capabilities, better tools (high level of function development) for further self-improvement (expansion of motor and cognitive capabilities), and this further contributes to their motor-cultural, body-cultural, intellectual-cultural progress [15, 16, 24].

Aim of the study: theoretical justification of a new interpretation of the main definitions of the PCT's categorical and conceptual framework (in the light of recent research) based on a semantic analysis to obtain interpretations available for a broader group of population, who currently use the term "physical culture" in its somewhat distorted meaning.

Methods and organization. The study included methods of theoretical analysis, generalization and synthesis of online (eLibrary.ru, CyberLeninka scientific online libraries, Lan system, disserCat dissertation library etc.) scientific research in the field of pedagogy and PCT.

Results and discussion. Construction of semantic relations and semantic ranks of key word combinations has allowed to identify the definitive cluster of the term "physical culture" as "cultivation of human nature with the aim of its improvement" and to present it by the following chain of combined terms: physical culture → motor culture → nutrition culture → body culture → health culture. Consequently, from the culturological and anthropological positions, "personal physical culture" as an integrative concept is a set of cognitive, motor, gastronomic (or nutritional), corporeal and valeological values that provide homeostasis of an individual (and, therefore, the human

population as a whole) in the actual for a particular cultural and historical stage of society development in its inherent natural and socio-environmental conditions.

The word combination used in our modern understanding as "physical culture" was first applied in England at the end of the XIX century as the term "bodily culture" in the semantic meaning of "culture of the human body" [10]. In Russia, the word combination became popular in the early XX century in the modern interpretation as the term 'physical culture'. At that time physical culture was understood as human and social activity aimed at physical education and health improvement [13, 16]. Nowadays, the most accessible for an ordinary user and popular among other interpretations (the first that appears on a monitor after a Google search) is a thesis, which is a result of collective scientific labor of internet users, who wished to participate in the interpretation of this term, taking into account the numerous points of view of physical culture theorists and practitioners (including ours): physical culture is a part of the general culture of mankind, which is a combination of intellectual, spiritual and material values (scientific and popular knowledge; motor, corporeal and behavioral standards, norms and traditions; physical culture and sport inventory, equipment, constructions etc), created and used by society for multidirectional physical, spiritual and intellectual development (activity), creation of a healthy lifestyle and health itself, as well as social adaptation through physical education.

The same source points that the term "culture" means "cultivation" in ancient Greek, "physics" (physical) – "nature" (natural). While linking these word forms in a word combination, it is logical to assume that when we say "physical culture", we mean "cultivation of human corporeal nature", i.e. we have a purposeful influence on the natural development of an individual of "Homo sapiens" for the purpose of motor (expansion of the motor capabilities) and corporeal (improvement of external forms and functions) improvement, aimed at increasing the quality of life activity in its subsequent interaction with the surrounding biogeosociococenosis (biological, geographical and social environment of a particular human population). In this case, the key points are taken by the main measure of physical culture, i.e. physical exercise (or modelled and repetitive motor action, subject to an objective of physical improvement of a human) and motor activity in whole, which play the role of a bricklayer that creates a cultural and natural masterpiece – a proportionally constructed and functionally independent human body – from the building materials that the body receives (food).

In other words, physical culture lies at the basis of personal self-sufficiency. According to the studies of I.A. Nikonova (2010) [25], the definition of "self-sufficiency" is interpreted as a "complex organization of combined internal qualities of a person (including physical ones), allowing it to successfully realize itself in creative, social and professional activities and meet the requirements of society for all members of a given society, and bring inner satisfaction from the results of these activities".

Thus, physical culture is the "keystone" in destiny of both one specific person and all representatives of a world society in whole (it can be said that it is manifested in the indicators of efficiency of the motor-active material or physical body as a multifunctional biological carrier, expressor and embodiment of human cognitive potential). From the point of view of philosophical anthropology that suggests considering the definition of "personal physical culture" as a result of spontaneous (daily motor activity) and purposeful (specific motor activity) motor and gastronomic interaction with (but not limited to) the environment, contributing to improvement of human's nature through creation of intellectual, spiritual and material values, we can logically relate the following concepts as constituent components and accompanying definitions [6, 17, 18, 21, 22]:

- motor culture (as a set of traditional, basic and elite values of human motor sphere (physical qualities and motor skills), providing safe and effective interaction with the environment as well as mastering of movements, forms and functions of the body);
- nutrition culture (as a set of nutritional, etiquette and dieting values, providing metabolism with bioenergetics (energy function of nutrients) and "building" (plastic function of nutrients) materials for cognitive, corporeal and functional development of an individual and their motor interaction with the environment);
- body culture (as a set of aesthetic, hygienic and plastic values, providing proportional body constitution and effective interaction of a human

with the environment through the musculoskeletal system, as well as a carrier, an embodiment and expressor of personal cognitive functions);

- health culture (as a set of cognitive, motor, gastronomical and corporeal values, providing human homeostasis as an open biological system in biogeosociocenosis).

Since the basis of a human's physical culture includes motor culture (as a locomotive that sets in motion the whole composition of subsequent types of personal culture), and any cultural motor action (creative, sports, combat, labor, household, leisure, etc.) is a civilizational value [7, 23, 26, 27], it makes sense to dwell on its definitive structure, consisting of the following main components: mass (basic), popular and elite [19, 20].

The elite motor culture is a set of motor and cultural values (motor standards or motor masterpieces), represented by various forms of individual and collective high-cultural movement activity in the performing arts (ballet, choreography, etc.), elite sports (variety of sports: gymnastics, track-and-field, martial arts, sports games, etc.), and integrative forms that combine the first two (figure skating, ice theatre or circus on ice, ice performances, circus art, etc.), which belong to creative and sporting professional communities [18].

Popular motor culture is a set of motor and cultural values (motor relics), represented by forms of individual and collective traditional motor and cultural activity formed over many generations and reflected in motor-activity and behavioral algorithms of demographic social and ethnic communities (folk dances, rituals, games, festivities, etc.), which are characteristic to a greater extent of the rural population of the modern world community [17, 18].

Mass (basic) motor culture is a set of motor and cultural values (physical conditions, motor skill, static and dynamic position, locomotion, motor manipulation and imitation), represented by everyday forms of individual and collective motor-cultural activity in domestic, labor, leisure and other spheres of human life, as well as regulated by generally accepted norms of behavior, canons of a healthy lifestyle and mass physical culture and sport [17, 18].

Thus, if we return the origins, as it was already established earlier in historical and theoretical studies, the foremother of physical exercises was existential combat (ensuring the survival of an individual in combat interaction with animals and similar beings in hunting and warfare) [13, 17, 27] and labor (ensuring the survival of an individual in labor interaction with flora and fauna in the process of building a house, cultivating soil, preparing food for oneself and for animals as well as caring for them etc) motor activity, then the change in the purpose of combat and labor actions, as well as the ways of their performance contributed to the development of methods of physical improvement of a human with the same purpose – for even more successful interaction with the surrounding biological and social environments in different climatic and geographical conditions. And this puts the mass (basic) motor culture among the others as the top priority, as preserving homeostasis not only for a particular individual (or a small elite community), but for the whole human population on the Earth as a whole.

Consequently, from the culturological and anthropological positions [15, 16, 26], "personal physical culture" as an integrative concept is a set of cognitive, motor, gastronomic (or nutritional), corporeal and valeological values that provide homeostasis of an individual (and, therefore, the human population as a whole) in the actual for a particular cultural and historical stage of society development in its inherent natural and socio-environmental conditions.

Conclusion. In connection with the newly discovered scientific knowledge and research approaches in philosophical anthropology, pedagogy and sociology of personal physical culture the process of forming the PCT's categorical and conceptual framework cannot be static. It is dynamic, and it allows to timely correct the interpretation of the main terms and concepts in accordance with semantic canons relevant for a particular historical period, allowing a more realistic reflection of the relationship between the subject and the term representing it. Thus, on the basis of semantic analysis of recent theoretical studies, the interpretations of the main definitions of the PCT's categorical and conceptual framework are supplemented and updated, which will be available to a broader group of people both in the common environment and in the pedagogical one, among physical culture and sport specialists. The study identifies the constituent components of the definitive cluster of generic concepts

"culture" and "physical culture", presented as a set of terms united by semantic chain: culture ↔ physical culture ↔ motor culture ↔ nutrition culture ↔ body culture ↔ health culture. All the above proposed concepts form directly the semantic and content structure of movement culture at all its levels (elite, popular and mass), which allows us to define its role as leading in the formation of personal physical culture, and basic movement culture as a priority in the homeostasis of the human population. In our opinion, the obtained results of the study represent a certain theoretical significance and can be used in the TPC in the category of complementary scientific knowledge in the scientific branch of the same name.

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