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IMPROVEMENT OF UPPER LIMB FUNCTIONALITY AFTER SHOULDER JOINT ARTHROPLASTY BY MEANS OF PHYSICAL THERAPY

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Annotation. The article presents the results of the upper limb functionality after shoulder arthroplasty using physical therapy. The duration of the physical therapy course aimed at restoring the functionality of the upper limb after shoulder arthroplasty was 4 weeks. The following were used in the recovery: therapeutic gymnastics, therapeutic massage, hydrokinesitherapy, electrical myostimulation of the shoulder muscles, mechanotherapy, and exercises on cable machines. Restoration of the upper limb functionality after shoulder arthroplasty using physical therapy is determined by a reliable ($p \leq 0.05$) improvement in the following indices: when conducting goniometry, the amplitude of shoulder abduction to the side increased by 51%; the circumference of the upper third of the shoulder increased by 6%, the middle third of the shoulder ($p \geq 0.05$) – by 4.5%, the lower third of the shoulder – by 8%. The strength of the upper limb muscles, assessed by wrist dynamometry, increased: in the healthy arm – by 3.6%, in the operated arm – by 27.7%. The results obtained during the study reflect the improvement of the functionality of the upper limb after shoulder joint arthroplasty using physical therapy means.
Keywords: recovery, functionality, upper limb, shoulder joint, arthroplasty, physical therapy means.

Introduction. The incidence of the shoulder rotator cuff injuries ranges from 16% to 45% of all injuries of soft structures in large joints [1, 2]. In some cases, these injuries are the result of acute trauma, they are often the result of chronic microinjury, and asymptomatic rotator cuff injuries may occur [1].

One of the operative ways of treating the ligamentous system of the shoulder joint is arthroscopy [3, 4]. Meanwhile, in a long-term postoperative period after restoration of anatomical integrity of the damaged structures of the shoulder rotator cuff, patients still have significant functional disorders, such as pain, restriction of shoulder joint mobility and reduction of the quality of life caused by the aforementioned factors [1, 5].

Inadequate rehabilitation measures in a postoperative period lead to a significant deterioration of clinical outcomes. In this regard, the issues of postoperative rehabilitation of patients remain of high scientific and practical importance and are widely discussed in the professional environment. In particular, the issues of selecting the most effective rehabilitation programs with the use of physical therapy (PT), controlled physical activity, and patient activation rates remain relevant [2, 5, 6, 7].

Aim of the study: assessment of the upper limb functionality after shoulder joint arthroplasty by means of PT.

Methods and organization. The study took place in the Neuro-Clinic LLC (Moscow). It involved men (n=10, age – 25-35 years) with damaged structures of the shoulder rotator cuff after shoulder joint arthroplasty in a long-term postoperative period. The main complaints from the patients included an inability to work out as usual, shoulder joint pain, reduced movement amplitude in the shoulder joint.

We examined the injured upper limb's functional state with the following methods:

1) goniometry (°);

2) wrist dynamometry (kg);

3) anthropometry (circumferential dimensions of the shoulder muscles – biceps, triceps and deltoid, cm).

The physical therapy course aimed at recovery of the upper limb functionality after shoulder joint arthroplasty took 4 weeks. The following were used: therapeutic gymnastics (every other day, 20 to 40 minutes), therapeutic massage (15 procedures), hydrokinesitherapy (3 times a week for 25 minutes), shoulder muscle electrical myostimulation (10 procedures), mechanotherapy on ARTROMOT S3 (3 times per week for 30-40 minutes), sessions on cable machines (we applied resistance with 50-85% of the maximum weight possible, 3 times a week, 60-80 minutes).

The obtained results were statistically processed with the Statistica 13 software package, the following were calculated: arithmetic mean (X) and standard deviation (σ). The reliability of the differences between the parameters during the study was studied by the Wilcoxon's signed rank test ($p<0.05$).

Results and discussion. Restoration of the upper limb functionality after shoulder joint arthroplasty is determined by a reliable improvement of the studied indices (table). When conducting goniometry, the amplitude of shoulder abduction to the side ($p\leq0.05$) increased by 51%: from 99.0±0.69° to 149.7±6.5°.

Table

The upper limb functionality after shoulder joint arthroplasty when using means of PT, X±σ

Index	Before PT	After PT
Shoulder joint goniometry, °		
Shoulder abduction to the side	99.0±0.69	149.7±6.5*
Anthropometry of the operated arm's shoulder muscles, circumference, cm		
Upper third of the shoulder, cm	31.12±0.4	33.0±1.98*
Middle third of the shoulder, cm	29.0±0.48	30.3±2.02
Lower third of the shoulder, cm	25.0±0.79	27.0±2.34*
Wrist dynamometry, kg		
Strength of the healthy arm, kg	37.0±4.62	39.06±4.64*
Strength of the operated arm, kg	25.8±2.41	35.67±3.72*

Note: PT – physical therapy; * – reliable changes in the index, $p\leq0,05$

Positive changes were revealed in the anthropometry indices of the operated arm's shoulder muscles (cm) after physical therapy (table, fig.). A circumference of the upper third of the shoulder increased ($p\leq0.05$) by 6%, from 31.12±0.4 cm to 33.0±1.98 cm, middle third of the shoulder ($p\geq0.05$) – by 4.5%, from 29.0±0.48 cm to 30.3±2.02 cm, lower third of the shoulder ($p\leq0.05$) – by 8%, from 25.0±0.79 cm to 27.0±2.34 cm (fig).

Fig. Changes in the anthropometry of the shoulder muscles in the operated arm (cm) with the use of physical therapy (PT)

Muscle strength of the upper limbs, estimated with wrist dynamometry, also improved: the healthy arm – by 3.6% from 37.0±4.62 kg to 39.06±4.64 kg, the operated arm – by 27.7% from 25.8±2.41 kg to 35.67±3.72 kg.

Conclusion. Assessment of the upper limb functionality after shoulder joint arthroplasty demonstrated positive changes when using means of PT, which reflects the effectiveness of introducing the developed rehabilitation method for the studied population in a long-term postoperative period.

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

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RESTORATION OF WALKING FUNCTION IN ELDERLY PEOPLE WITH TYPE 2 DIABETES AFTER AMPUTATION OF THE MIDDLE THIRD OF THE LOWER LEG

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Abstract. The article presents the content and results of the course of comprehensive introduction of forms and means of physical therapy aimed at restoration of walking function in elderly people with type 2 diabetes mellitus after amputation of the middle third of the lower leg. Objective data are presented proving the effectiveness of the course, as a result of which the subjects' step symmetry on the operated limb improved by 12% from 58.37±3.71% to 51±1.00% and step symmetry on the intact limb increased from 42.87±1.76% to 49.0±1.00%. Walking speed increased by 36.6%, walking cadence increased by 34.8%. Support reaction force (kg) on the prosthesis increased by 13% and in the intact limb by 12%. Pain sensitivity of the intact limb decreased by 3.3% and pain sensitivity of the stump increased by 42.5%.

Keywords: restoration of walking function, amputation of the middle third of the lower leg, elderly people, diabetes mellitus, mechanotherapy, controlled walking, Nordic walking, therapeutic exercises.

Introduction. In the structure of endocrine system pathologies diabetes takes about 60-70% of their total number. According to the International Diabetes Federation, a number of patients all over the world is 500 million (data from 2021). Risk factors of type 2 diabetes development include obesity, genetic predisposition, increased blood cholesterol, sedentary lifestyle et al. Type 2 diabetes often starts developing in middle and old age and causes great damage to the body, especially to the nervous system and blood vessels [1, 2]. One of late diabetes complications is lower limb gangrene resulting in amputation, which is a serious injury. After amputation of the middle third of the lower leg, the static and dynamic work of the skeletal muscles is impaired, motor stereotypes are disturbed, coordination and balance function deteriorates, contractures occur in nearby joints, and the quality of life deteriorates [3-5]. Prosthesis after amputation is an integral part of recovery, the effectiveness of which depends on the quality of prosthetic implant construction and preparation for the surgery. The level of amputation of the operated limb, the stump condition, and training for the correct use of the prosthetic implant play a crucial role [6]. The process of walking function restoration is an integral part of adaptation of this contingent to new living conditions, in which the key aspect is the complex application of means and forms of physical therapy [7, 8].

Aim – to restore the walking function in elderly people with type 2 diabetes after amputation of the middle third of the lower leg.

Methods and organization. The study was conducted in the Center of Innovation Techniques in Orthopedics, from June to August 2023, it included men (n=8) diagnosed with type 2 diabetes after amputation of the middle third of the lower leg in the long-term postoperative period. The time after amputation was not earlier than 6 months. The mean age of the subjects was 61.0±1.7 years. The study of walking was carried out with motor testing on the C-mill rehabilitation complex (Physiocom). The following parameters were evaluated: step width (%); step symmetry on the intact limb (%) and on the operated limb (%); walking speed (km/h) and cadence (step/min); support reaction on the operated limb (kg) and on the intact limb (kg). The assessment of pain and tactile sensitivity at rest was studied with the visual analogue scale (VAS). The arithmetic mean (X), standard deviation (σ) were calculated using math-and-stats methods. The degree of reliability of the obtained data of

parametric indicators was identified with the Student's T-test, the data of nonparametric indices were assessed with the Wilcoxon's signed rank test.

The course for restoring the walking function by means of physical therapy lasted for 70 days and included three periods: introductory – 20 days, main – 30 days and final – 20 days, each of them solved the following tasks: improvement of the state of the cardiorespiratory system; blood glucose reduction; carbohydrate metabolism normalization; preparing the body for gradually increasing loads; patient verticalization; improvement of blood circulation in the lower limbs and in the whole body; development of the proper walking pattern; psychoemotional state improvement; improvement and training of coordination and balance functions; elimination of contractures and stiffness in the operated limb joints; strengthening of the operated and superior muscles of the stump and muscles of the intact lower limb; increase in the strength of the trunk and shoulder girdle muscles.

In the introductory period of the recovery course, therapeutic exercises were performed every other day for 35-45 minutes, the main part consisted of special exercises for coordination and balance, stretching and relaxing muscles, with objects, on equipment, phantom exercises for the stump muscles – at an average pace while sitting and standing up. Therapeutic massage is performed in a course of 10 procedures every other day for 15-20 minutes in order to reduce muscle fatigue, relieve pain, restore and strengthen muscle tone, improve blood and lymph circulation. Controlled walking introduced daily, the cadence was 60-70 steps/min, the distance was 150 m, gradually increased to 1 km. Physical therapy and independent sessions were conducted every other day.

In the main period of the recovery course, the following tasks were additionally addressed: improvement of the upper and lower limb muscle blood and nerve supply; strengthening of upper limb support; complication prevention. The means and forms were supplemented with Nordic walking performed daily for 25-35 minutes; circular shower procedures with gradual reduction of water temperature from 36°C to 25°C. The time was increased to 45-60 minutes. Special exercises were aimed at strengthening the muscles of the upper and lower limbs, developing the proper walking pattern, exercises in stepping, training and improving the balance function, strengthening the trunk and shoulder girdle muscles. The therapeutic exercise sessions included exercises on the C-mill rehabilitation complex and the COBS force plate for 15-20 minutes each, with rest pauses (1 minute) between sets. Therapeutic massage (15 procedures) was performed on days when no physiotherapy procedures carried out. Exercises on machines (C-mill, COBS) included walking on a treadmill and walking with parallel bars. In addition, exercises on an unstable platform were included, performed every other day for 15-20 min with gradual complication and, as the movement coordination improved, without additional support. This period also included game elements (throwing a ball to the patient, etc.).

In the final period (20 days) the following tasks were solved: improving the total body endurance; metabolism normalization. The following forms of recovery were included in this period: therapeutic exercise, therapeutic massage, dosed walking, independent sessions. During this period, the time of therapeutic exercise sessions introduced every other day was increased up to 50-60 min. The methods of independent sessions and therapeutic massage remained unchanged. Walking time, carried out every other day at a cadence of 90-120 steps per minute with increasing the distance up to 3-4 km, was 30 min.

Results and discussion. After the recovery course, the study population showed an improved walking function in the studied parameters (table).

Table

Changes in motor test data on the C-mill of the studied group before and after the walking function restoration course, X±σ

Motor test	Before	After	P≥
Step width, m	0.156±0.03	0.177±0.02	0.05
Step symmetry on the operated limb, %	58.37±3.71	51.0±1.00	0.05
Step symmetry on the intact limb, %	42.87±1.76	49.0±1.00	0.05
Speed, km/h	1.49±0.17	2.35±0.24	0.05
Cadence, steps/min	58.88±5.80	79.37±4.97	0.05
Support reaction on the operated limb, kg	69.92±17.13	79.92±12.65	0.05
Support reaction on the intact limb, kg	70.93±16.89	80.03±12.66	0.05

According to the results of the study, there was an increase in the step width from 0.156±0.03 to 0.177±0.02 m with an improvement of 12%. In assessing the step symmetry, there was a decrease in the values on the operated limb from 58.37±3.71 to 51±1.00%. The step symmetry on the intact limb increased from 42.87±1.76 to 49.0±1.00%.

A comparison of walking speed showed an increase of 36.6%: from 1.49±0.17 to 2.35±0.24 km/h. The walking cadence increased by 25.8%: from 58.88±5.80 to 79.37±4.79 steps/min. There was also an increase in the support reaction on the operated and the intact limb from 69.92±17.13 to 79.92±12.65 kg and from 70.93±16.89 to 80.03±12.66 kg respectively.

Pain sensitivity on the intact limb has reduced by 3.3%: from 4±0.71 to 3.87±0.60 points, Pain sensitivity on the operated limb has increased by 42.5%: from 1.87±1.17 to 3.25±0.66 points.

Conclusion. Comprehensive introduction of means and forms of physical therapy, such as therapeutic exercise, therapeutic massage, mechanotherapy, controlled walking, Nordic walking, hydrotherapy, physiotherapy, contributed to an increase in step width, an increase in walking speed, an improvement in the support response on the operated and the intact limbs; a decrease in pain sensitivity on the intact limb and an increase on the stump in the studied patients with type 2 diabetes after amputation of the middle third of the lower leg, reflecting the return of the lost sensitivity of the operated limb.

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

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CONSERVATIVE RECONSTRUCTIVE TREATMENT OF ACHILLES TENDINOPATHY FOR ELITE ATHLETES OF VARIOUS SPORTS

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Abstract. The aim of the study – development and scientific substantiation of the conservative reconstructive treatment of Achilles tendinopathy for elite athletes of different sports. The study involved 120 highly qualified athletes with complaints of pain in the Achilles tendon area during training camps. According to the survey results, the athletes with calcification and exostosis detected on ultrasonogram had undergone a 5-procedure course of extracorporeal shockwave therapy. The athletes with anterior (or posterior) Achilles tendon bursitis after surgical treatment of the ankle were treated with a course of combined endomassage and magnetic field (MANTIS MR991). The results have shown that endomassage and magnetic field combined with the optimized lower leg muscle balance in acute and subacute Achilles tendon injuries is a more effective method than extracorporeal shockwave therapy, except in cases of chronic injuries. After the treatment, signs of inflammation in the Achilles tendon have been eliminated, and the athletes were able to regain their former level of motor activity.
Keywords: athletes, muscle strength, muscle balance, Achilles tendinopathy, anterior (posterior) Achilles tendon bursitis, extracorporeal shockwave therapy, pulsating magnetic field, stimulation electromyography.

Introduction. Exposure to intense and prolonged physical activity, constrained posture in sports exercises cause adaptive changes of the neuromuscular system of athletes [1-5], which can result in muscle imbalances. As noted by experts, muscle imbalances are caused by impaired muscle antagonism and myotatic reflexes as a result of prolonged same-type training exercises and disproportional strength [6]. Neuromuscular imbalance is accompanied by redistribution of loads in the kinematic chain links with the development of biomechanical disorganization and the emergence of compensatory processes [7].

Track-and-field athletes engaged in high running activity may have an imbalance in the lower leg flexors/extensors that disturbs natural asymmetry and enhances dystrophic reactions in the Achilles tendon [8]. An incomplete recovery from the fatigue-related Achilles injuries leads to additional stress and increased risk of re-injury, Achilles tendon ruptures, reduces a possibility of regaining former motor activity [9]. Therefore, there is a need in the development of a method of effective conservative reconstructive treatment of Achilles tendinopathy for elite athletes of different sports.

Methods and organization. The study involved 120 athletes (qualification: MS (Master of Sports), MS IC (Master of Sports of International Class), HMS IC (Honored Master of Sports of International Class); sports: rhythmic gymnastics, track-and-field, fencing, judo, triathlon, field hockey; age – 17 to 30 years) during training camps. The athletes complained of pain in the Achilles tendon area during or after training.

For proper rehabilitation and treatment of Achilles tendinopathy we need to consider peculiarities of the ankle joint anatomy (fig.).

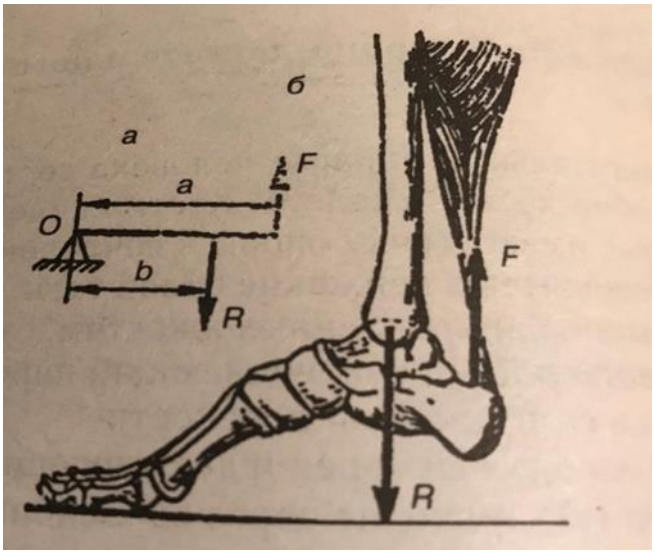

Fig. The ankle joint anatomy

The ankle joint is a second-class lever. The axis of oscillation (O) passes through the head of the metatarsal bones, and two forces are applied on the foot on the same side of the axis. The force of gravity (R) is equal to the half of the force (½R) applied to the whole body. The leverage of this force is labelled b, i.e. the distance from the joint of the foot to the contact point between the metatarsus and the floor (usually 12 cm). The traction force (F) is transmitted by the Achilles tendons and is applied to the back of the heel, the leverage of this force is labeled a, i.e. the distance from the fulcrum to the point of action of the Achilles tendons (usually 18 cm), the lever balance condition is F*a = R*b, in this case a>b = >F<R, so by strengthening the flexors we gain in strength but lose in speed. The Achilles tendon has a very poor blood supply. The Achilles tendon is perfused by the paratenon vessels, which are branches of the posterior tibial and peroneal arteries. The middle part of the Achilles tendon has the poorest blood supply. In case of elastic lengthening of the Achilles tendon, the temperature rises to 45° in the tendon's thickness after 7 minutes. Tenocyte death occurs at this temperature. Only a proper blood supply allows sufficient hemostasis by cooling the tendon.

Taking the above-mentioned into account, we have developed the following method. The athletes with calcification and exostosis detected on ultrasonogram (27 track-and-field athletes) had undergone a 5-procedure course of extracorporeal shockwave therapy (ESWT) on WellWave ("PHYSIOMED"), a trigger-point effect was applied at 14-20 intensity level and 6 Hz shock frequency in the place of distal enthesis.

The athletes with anterior (or posterior) Achilles tendon bursitis after surgical treatment of the ankle joint (93 athletes of different sports) were treated with a course of procedures on the MANTIS MR991 complex (endomassage and magnetic field). The procedures were performed with the "VIXO" handpiece, following characteristics were applied: vacuum pump pressure – 0 to -75 kPa, peak magnetic induction on the surface of the handpiece's emitter inductors – 0.85.3±5% mT; stochastic pulses of electromagnetic field – 0.1 kHz to 1 MHz. The spot analgesia procedure in the professional mode was applied: 10 minutes in the spot suction mode (suction force – 70, suction frequency – 5) and 10 minutes in the magnet therapy mode with the "Dolobene" ointment. The effect was applied to the place where the Achilles tendon is attached to the heel tubercle and to the calf muscle. The course included 5-7 procedures.

The ultrasound study of the Achilles tendon was done on MyLab90 ("Esaote", Italy) with 12-15 MHz high-frequency linear markers. The Achilles tendon was examined from the point of attachment to the heel bone to the transition to the calf and soleus muscles. Dimensions of

the tendon depended on gender and type of sport: thickness did not exceed 5-6 mm, width at the attachment point varied from 10 to 19 mm, length – 70-110 mm. Echographic signs of tendinopathy included spindle-shaped thickenings and decreased echogenicity of the examined tendon in comparison with the opposite tendon. Some track-and-field athletes had hyperechogenic spot inclusions: calcification or signs of upper exostosis formation were identified in the place of distal enthesis. In some cases tendinopathy was accompanied by echo-signs of anterior Achilles tendon bursitis.

Therapeutic exercise and the study of the functional state of the musculo-articular system of the ankle joint were performed on the CON-TREX MJ complex. Muscle strength and flexibility tests of flexors and extensors of both legs were performed in the isokinetic ballistic mode with a given speed and a given movement amplitude in degrees. Twenty repetitions with a pause of 10 s each were performed. The work of ankle flexors and extensors of the right and left lower legs was evaluated: maximum torque (N•m), maximum angle (º), work, fatigue (J/s), work average (J), power average (W).

The statistical data processing was carried out in Statistics 13.0. We calculated standard indices of descriptive statistics (mean (M) and error (m)). The Wilcoxon signed rank test was used in comparison of the indices before and after the course.

Results and discussion. According to the results of the ESWT course, all the athletes showed a tendency for optimizing balance of the lower leg flexors and extensors and improving the functional state of the musculo-articular system of the ankle joint. Subjectively the patients noted reduced pain symptoms and demonstrated a possibility to fully participate in the training process. According to the medical survey data, the inflammation signs have been eliminated, the volume of movement in the ankle joint has also increased. The data on the work of the lower leg flexors and extensors among elite track-and-field athletes before and after ESWT and therapeutic exercise on CON-TREX MJ are presented in table 1.

Table 1

Work of the lower leg flexors and extensors in elite track-and-field athletes before and after ESWT and therapeutic exercise on CON-TREX MJ

	Before	After	Before	After
Maximum torque, N•m/kg				
	Left leg		Right leg	
Extensors	34.0±13.7	38.5±12.8	45.0±25.7	49.4±22.4
Flexors	43.1±16.3	42.7±12.6	51.0±25.5	50.7±22.8
Fatigue, J/s				
	Left leg		Right leg	
Extensors	0.1±0.1	0.2±0.2	0.1±0.1	0.1±0.1
Flexors	0.1±0.1	0.1±0.1	0.1±0.1	0.1±0.1

Note: ESWT – extracorporeal shockwave therapy

Comparison of results received before and after the course of spot analgesia procedures on MANTIS MR991 (endomassage and magnetic field) have demonstrated a significant improvement of almost all the indices of the functional state of the musculo-articular system of the ankle joint both for flexors and extensors of both legs (table 2).

Table 2

Indices of the functional state of the musculo-articular system of the ankle joint in athletes with anterior Achilles tendon bursitis before and after endomassage and magnetic field in the "spot analgesia" mode

Indices	Right leg		P	Left leg		P
	before	after		before	after	
Flexors						
Maximum torque, N•m	36.6±14.0	50.1±16.6	0.0004	35.9±13.2	47.7±17.8	0.0004
Maximum angle, °	26.1±5.2	18.9±6.8	0.004	26.9±5.9	23.2±10.1	0.004
Work, fatigue, J/s	0.4±0.5	0.6±0.5	-	0.2±0.4	0.1±0.1	-
Work average, J	4.9±1.3	5.6±1.5	0.03	5.7±2.0	6.3±2.6	-
Power average, W	5.7±2.0	7.0±1.7	0.005	6.6±2.8	8.2±2.4	0.004
Extensors						
Maximum torque, N•m	21.1±10.5	39.5±14.4	0.005	15.1±4.1	26.6±6.3	0.0004
Maximum angle, °	4.1±2.7	5.4±4.0	0.007	2.5±1.1	4.3±2.6	0.004
Work, fatigue, J/s	0.1±0.0	0.0±0.0	0.002	0.0±0.0	0.0±0.0	-
Work average, J	3.1±1.2	2.9±2.2	-	4.5±2.0	5.6±2.0	0.0001
Power average, W	3.2±1.2	2.1±1.4	0.004	4.5±2.0	5.9±1.1	0.004

Conclusion. Consequently, application of endomassage and magnetic field combined with the optimized lower leg muscle balance in acute and subacute Achilles conditions is more effective than ESWT. However, in chronic injuries, ESWT is still a very highly effective method. In both groups, the magnitude of pain sensations decreased and the functional state of the ankle joint muscular system improved. In all the athletes, the signs of inflammation in the Achilles tendon area were eliminated and the former motor activity was restored.

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

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CAUSAL RELATIONSHIP OF GRIP STRENGTH WITH THE RISK OF CHRONIC DISEASE AND MORTALITY (NARRATIVE REVIEW)

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Abstract. Grip strength and common chronic diseases often coexist, but establishing a causal relationship in observational studies is difficult. Mendelian randomization studies are a rational method for determining cause and effect. To analyze Mendelian randomization studies examining the association between grip strength and various chronic diseases and mortality. A search was conducted in the information databases PubMed/MEDLINE, Scopus, Google Scholar for the period from June 20, 2017 to September 1, 2024. The analysis included 42 studies with Mendelian randomization, establishing causal relationships between grip strength and chronic diseases (cardiovascular disease, cancer, depression, cognitive functions, chronic obstructive pulmonary disease, osteoarthritis, osteoporosis, type 2 diabetes, resistance insulin), and cardiovascular and all-cause mortality. Results from Mendelian randomization studies demonstrate a causal relationship between low grip strength and adverse health outcomes. Grip strength is an important risk factor for many chronic diseases and is also a predictor of all-cause mortality and cardiovascular disease. Maintaining muscle strength is an important factor in preventing many common diseases, as well as reducing the risk of mortality in the population.
Keywords: Mendelian randomization, grip strength, cardiovascular diseases, type 2 diabetes, depression, chronic obstructive pulmonary disease.

Introduction. Grip strength is a reliable indicator of total muscle strength among adults. Its decrease is associated with increased all-cause mortality along middle-aged and elderly people [1]. Grip strength measurement is an inexpensive and simple test, which makes it one of the most frequently used muscle strength markers. Grip strength, a predictive marker of healthy aging, was connected with a risk of chronic diseases in observational studies [2]. In particular, higher grip strength was associated with lower risk of cardiovascular diseases (CVDs) [3], type 2 diabetes mellitus (T2DM) [4], metabolic syndrome (MS) [5], chronic obstructive pulmonary disease (COPD) [6], lupus [7], oncological diseases [1], cognitive disorders [8]. However, such studies may be subject to distortions related to a causal relationship.

Observational epidemiological studies have repeatedly identified several beneficiary associations that were rejected when tested in standard randomized controlled trials (RCTs). A more feasible method, very similar to RCTs and with the potential to establish a causal relationship between modifiable exposures and disease outcomes, is known as Mendelian randomization (MR). This method uses genetic variants associated with modifiable traits/ exposures as tools to detect causal and directional associations with outcomes [9].

Objective: to analyze MR studies examining the association between grip strength and various chronic diseases, as well as mortality.

Methods and organization. Search for, processing and systematization of scientific data, theoretical analysis, logical generalization, translation.

The study's tasks:

1. Analyze MR studies examining the causal relationship between grip strength and mortality.

2. Analyze MR studies examining the causal relationship between grip strength and various chronic diseases.

3. Identify potential mechanisms of a positive effect of grip strength on chronic diseases and mortality.

Results and discussion. We have conducted a literature search on the set topic in PubMed, Scopus and Google Scholar for the

period from June 20, 2017 to September 1, 2024. 42 MR articles dedicated to the causal relationship between grip strength and various chronic diseases, as well as mortality, were included in the analysis.

The causal relationship between grip strength and mortality. With the use of MR, when studying 111 348 tests subjects with the available genetic and phenotypic data, it was found that genetically predicted higher grip strength reduced CVD and all-cause mortality [10]. In another study involving 337 138 people of white British origin, genetically predicted low grip strength was associated with a higher risk of all-cause mortality [11]. MR conducted on European population-based data using inverse-variance weighting found significant causal associations between low grip strength in people aged 60 years and older and an increased risk of all-cause mortality [12]. Thus, several MR studies have found that sarcopenia, which includes low grip strength, is associated with higher both CVD and all-cause mortality, emphasizing the role of grip strength as an important predictive tool.

The causal relationship between grip strength and various chronic diseases. The CVD incidence and mortality increase around the world due to population aging [13]. A series of observational studies have investigated the association between grip strength and CVDs, however the data from these studies are contradictory. Thus, a meta-analysis of prospective cohort studies revealed that grip strength is an independent CVD predictor in the communities [14], but this association was eliminated after correcting the initial risk factors of CVDs in another prospective cohort study [15]. Therefore, the application of MR analysis to identify the association between grip strength and CVDs remains an important issue in the epidemiology of non-communicable diseases.

Genetically predicted low grip strength showed a causal effect on an increased risk of coronary heart disease (CHD) in an independent cohort of 337 138 people of white British origin (odds ratio (OR): 1.13; 95% CI: 1.04-1.22) [11]. Another bidirectional MR study using inverse-variance weighting found that high grip strength of both left and right hands was associated with a lower risk of CHD and myocardial infarction (MI), but not stroke [16]. However, there was no statistically significant causal effect of CVDs (CHD, stroke, MI) on grip strength. Meanwhile, another MR analysis demonstrated that increasing left hand grip strength by 1 kilogram reduced the likelihood of CHD by 36% (OR: 0.64; 95% confidence interval: 0.49-0.82), and increasing right hand grip strength by 1 kilogram reduced it by 41% (OR: 0,59; 95% CI: 0.48-0.75) [17]. Again, no causal effect of CHD on grip strength was found. Yet another MR analysis found that increasing genetically predicted grip strength by 1 kilogram reduced the likelihood of CHD by 6% (OR: 0,94; 95% CI: 0.91-0.99) and the likelihood of MI by 7% (OR: 0.93; 95% CI: 0.89-0.98) [18]. In the MR analysis of Ye C. et al [19] it was revealed that each decrease of genetically predicted grip strength by 1 standard deviation was associated with an increased risk of arterial hypertension (OR: 1.32; 95% CI: 1.09-1.60), CHD (OR: 1.42; 95% CI: 1.15-1.75) and MI (OR: 1.45; 95% CI: 1,15-1.82), but not small vessel stroke (OT: 1.25; 95% CI: 0.86-1.81). Earlier MR analysis discovered that higher grip strength protects from CHD (OR: 0.69; 95% CI: 0.60-0.79) and atrial fibrillation (OR: 0.75; 95% CI: 0.62-0.90) [20]. In addition, the MR analysis by Mendo C. et al [2] found that grip strength was inversely related to carotid intima-media thickness, i.e. a marker of vascular atherosclerosis. MR analysis of the UK Biobank cohort found that an increase in grip strength was associated with an increase in high-density lipoproteins and a decrease in low-density lipoproteins.

Therefore, the current data from MR studies shed light on the causal relationship between grip strength and major CVDs, suggesting a positive impact of improved muscle strength for both primary and secondary prevention of CVDs.

Depression is a severe mental illness that greatly affects physical and mental well-being, as well as quality of life in total [23]. More and more data from epidemiological studies reflect association between grip strength and depression. For example, a longitudinal study involving 115 601 elderly test subjects from 24

countries showed that grip strength was inversely associated with depression [24]. A genome-wide association study (GWAS) of the frailty index found an association with depression and neuroticism [25]. However, a direct causal relationship between grip strength and depression has hardly been studied at the population level. It is still uncertain whether there is a bidirectional causal relationship or whether it is due to the coexistence of mixed or shared risk factors such as aging.

An MR analysis with inverse-variance weighting, weighted median and MR-Egger methods demonstrated the statistically significant causal relationship between right and left hand grip strength and major depressive disorder [26]. In this case, major depressive disorder had a significant causal effect on appendicular muscle mass. In other MR analysis with weighted median, MR-Egger and MR-PRESSO (Mendelian Randomization Pleiotropy RESidual Sum and Outlier) methods, it was found that higher frailty index (OR: 1.86; 95% CI: 1.37-2.53), higher frailty phenotype score (OR: 3.00; 95% CI: 2.06-4.38) and lower grip strength (OR: 1.20; 95% CI: 1.05-1.37) were associated with a higher risk of depression. In terms of reverse direction, genetic predisposition to depression revealed a consistent association with higher strength index and higher frailty phenotype score, but not grip strength. Depression has also been found to be causally associated with telomere length shortening, increased frailty index and accelerated epigenetic aging [28].

Z. Li et al [29] discovered that low grip strength is associated with quicker loss of grey matter, especially in the hippocampus area, while S. Su et al [30] associated higher grip strength with an increase in the surface area of the medial orbitofrontal cortex and precentral gyrus. C. Lu et al [31] revealed that higher grip strength was associated with better cognitive indicators. In addition, Y. She et al [32] in their bidirectional MR analysis established the inversed causal relationship between grip strength and Parkinson's disease. Moreover, T. Wang et al [33] found that higher right and left hand grip strength were associated with a lower risk of levodopa-induced dyskinesia C. Ye et al. [34] found the causal relationship between lower grip strength and a higher risk of Alzheimer's disease.

Thus, MR analyses confirm the causal relationship between grip strength and depression, neurological diseases, brain aging and cognitive functions, which sets important prospects for the development of intervention strategies to maintain/support muscle strength and alleviate the aforementioned diseases.

COPD is a major global health problem, being the third leading cause of death globally [35]. A recent systematic review and meta-analysis found that people with lower grip strength have higher COPD incidence and mortality [36]. Although prior studies tried to identify a complicated association between grip strength and COPD incidence, this field remains understudied.

A bidirectional MR analysis conducted with the GWAS data from patients of European origin, examining the effect of grip strength on COPD using inverse-variance weighting found that genetically predicted lower grip strength was unidirectionally associated with higher COPD incidence, with gait speed being bidirectionally associated with COPD [37]. Moreover, another MR analysis discovered that genetic predisposition to higher grip strength was directly related to forced vital capacity of the lungs and forced expiratory volume in one second [39]. Another MR analysis found that Fried frailty index was associated not only with COPD but also with bronchial asthma [39].

Thus, the few data from MR studies provide preliminary evidence for using grip strength as an indicator for predicting COPD.

Osteoarthritis (OA) is a disease characterized by pain, stiffness, deformity and dysfunction of a joint and is one of the leading cause of disability [40]. In a longitudinal cohort study, lower muscle strength and muscle mass of the lower limbs were associated with higher knee OA incidence, and patients with sarcopenia were more likely to have symptomatic OA than patients without it [41]. Nonetheless, this and similar studies are based on observational cross-sectional analysis, and it is still unclear whether there is the causal relationship between traits associated with

sarcopenia and OA.

Chen S. et al. [42] in their MR analysis with MR-Egger found that higher right hand grip strength was associated with a reduced risk of knee OA (OR: 0.26; 95% CI: 0.09-0.67), total OA (OR: 0.37; 95% CI: 0.17-0.82). Similar estimation of the causal relationship for knee and total OA were received with inverse-variance weighting for both right and left hand grip strength. However, no statistically significant association between right and left hand grip strength and hip OA was discovered [42]. Another MR analysis found an association between lower grip strength with a higher risk of knee OA (OR: 1.46; 95% CI: 1.20-1.77) [43]. Moreover, OA was not associated with any sarcopenia signs (grip strength, appendicular muscle mass, gait speed). The MR analysis by Yang J. et al [44], only appendicular muscle mass had the causal relationship with knee and hip OA, but not grip strength.

Therefore, MR analyses have heterogeneity regarding the causal relationship between grip strength and OA. Perhaps the body composition (amount of muscle and fat tissues) may be a factor that contributes significantly in the study of association between sarcopenia (muscle strength and muscle mass) and OA. It is likely that the subgroups of sarcopenia and sarcopenic obesity need to be analyzed to better understand how grip strength and OA are associated.

With global population aging, incidence of osteoporosis (OP) and sarcopenia increases rapidly, which is associated with a high risk of fracture, reduced quality of life and early mortality. It is known that people with frailty often suffer from osteosarcopenia [45]. Moreover, there is a clinical study showing that sarcopenia increases a risk of 5-year mortality in patients with osteoporotic hip fractures [45]. Thus, elucidating the causal relationship between grip strength and OP is a clinically relevant problem.

We have found three MR analyzes examining association between grip strength and OP. An MR analysis by Ma X. et al [47] found that left and right hand grip strength were directly associated with mineral density of lumbar vertebrae. In an MR analysis by Y. Zhu et al. [48], decreased grip strength was associated with a risk of OP in people aged 45-60 years. On the other hand, an MR analysis by C. Liu et al [49] revealed that only appendicular muscle mass was directly causally related to mineral density of lumbar spine, but not to grip strength. The heterogeneity in the data of these MR studies may be due to different bone composition (cortical and trabecular bone, as well as significant regional variations in bone microstructure) from different areas of the skeleton, which is determined by genetic factors [50].

Thus, further studies are needed for a thorough research of the causal effect of muscle strength on bone mineral density in different segments of the skeleton.

Type 2 diabetes mellitus (T2DM) is one of the common metabolic disorders and is associated with comorbidities such as obesity, hyperlipidemia, hypertension, metabolic syndrome and CVDs [51]. A recent systematic review and meta-analysis found that higher both absolute and relative grip strength was associated with a reduced risk of T2DM [52]. Accordingly, establishing a causal relationship between grip strength and T2DM is necessary to develop new methods for the prevention, diagnosis and treatment of T2DM and other metabolic diseases.

A bidirectional MR analysis with inverse-variance weighting, MR-Egger and weighted median methods found that genetically predicted low grip strength was associated with T2DM (OR: 1.11; 95% CI: 1.01-1.22) [53]. In another MR study, grip strength was associated with T2DM when applying MR-PRESSO and MR-Egger methods, but it was not associated with it in case of inverse-variance weighting [54]. In another MR analysis by C. Ye [34], lower grip strength was associated with a higher risk of T2DM, non-alcoholic liver disease and insulin resistance. On the other hand, an analysis by L. Ren et al [55] revealed that decreased appendicular muscle mass increased a risk of diabetic nephropathy, and diabetic nephropathy was associated with decreased grip strength. In turn, the effect of T2DM on decreased grip strength has been demonstrated in most MR analyses.

Thus, grip strength and T2DM may have a reciprocal effect on each other. Data from MR studies provide strong evidence that grip strength is a possible T2DM predictor in middle-aged and elderly patients.

In addition, low grip strength was also causally associated with adverse pregnancy and perinatal outcomes [56]. An analysis by Z. He et al [57] showed that increased grip strength was associated with reduced breast cancer risk and longer survival time of breast cancer patients, but a reduced grip strength in an MR analysis by J Cao et al [58] was associated with an increased risk of hepatocellular carcinoma. Also, grip strength was inversely associated with inflammatory bowel disease [59].

The results of MR studies reflect the causal relationship between low grip strength and adverse health consequences. They have shown that men and women with lower grip strength face higher all-cause and CVD mortality, and are subject to a higher risk of chronic diseases.

The results of MR analyses have important public health implications. Lower grip strength is strongly associated with an increased risk of various diseases and mortality, indicating the importance of maintaining proper muscle strength for overall health. The mechanisms underlying this association are multifaceted. Grip strength serves as a surrogate marker for the early development of sarcopenia, reduced physical fitness and functional capabilities [60]. Meanwhile, lower grip strength potentially indicates reduced physical activity levels, increased systemic inflammation and impaired cardiovascular and metabolic function [61]. In addition, low grip strength may reflect a general decline in muscle mass and strength, which is often associated with age-related diseases and increased risk of adverse health outcomes [62, 63].

Conclusion. Thus, this review of MR studies emphasizes the importance of low grip strength as an independent risk factor for many chronic diseases, as well as a significant predictor of all-cause mortality. These results note the importance of maintaining muscle strength in the general population, as well as regular screening of this indicator for clinical practice and public health interventions.

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FITBALL GYMNASTICS IN THE DEVELOPMENT OF COORDINATION ABILITIES OF 10-11-YEAR-OLD SCHOOLCHILDREN WITH HEARING LOSS

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Abstract. The aim of the study – to substantiate a method of coordination ability development for 10-11-year-old schoolchildren with hearing loss by means of fitball gymnastics. The results of the conducted studies have proven that the most effective ways to develop coordination abilities of schoolchildren with hearing loss include physical exercises with fitball and elements from fitball gymnastics. The growth rate of the studied indices of the coordination ability development has changed from 16.4 to 30.4% in the experimental group, where we introduced elements from fitball gymnastics.
Keywords: coordination abilities, schoolchildren with hearing loss, fitball gymnastics.

Introduction. Disorders in the activity of the auditory analyzer alter the function of the vestibular apparatus, and vestibular abnormalities affect the formation of the motor sphere of children with hearing loss. The results of scientific studies have revealed various manifestations of vestibular dysfunction in 62% of hearing loss cases [1-3].

Researchers also note that schoolchildren with varying degrees of hearing loss are behind their hearing peers in terms of the level of development of physical qualities, especially pronounced delay is observed in terms of coordination abilities [1, 2, 4, 5, 6].

Recreation and sports activities under adapted educational programs in inclusive forms and in the system of special (correctional) general education institutions help to improve motor abilities and increase the level of physical fitness of schoolchildren with hearing loss [5, 7, 8, 9, 10].

Fitball gymnastics is a complex way and method of influence both in educational and health-improving direction of personal development of children and adolescents with hearing loss. Practically, it is the only type of gymnastics, where during physical exercises on fitballs the motor, vestibular, visual and tactile analyzers are simultaneously involved, which enhances the positive effect of this type of health-improving gymnastics. Exercises with a fitball develop the functions of the vestibular apparatus, movement coordination, balance function and spatial orientation in children with hearing loss [7-12].

The scientific literature analysis has demonstrated that currently such an effective method as fitball gymnastics is insufficiently studied and applied in adaptive physical education of schoolchildren from special (correctional) educational institutions [7, 11].

The search for and development of new scientifically justified methods of health-improving gymnastics introduction in classes for schoolchildren with various degrees of hearing loss are relevant.

The aim of the study – to substantiate a method for developing coordination abilities of 10-11-year-old schoolchildren with hearing loss by means of fitball gymnastics.

Methods and organization. In the study, we used the following methods: testing and assessment of the level of motor ability development of schoolchildren with hearing loss, pedagogical experiment, math-and-stats methods.

To identify the level of coordination abilities of 10-11-year-old schoolchildren with hearing loss we carried out a preliminary and control testing, the program of which included

the following motor tests.

The Romberg test (the classic variant: standing position with feet shifted (heels and toes together), eyes closed, arms stretched forward). The test reveals the ability to maintain static balance (Romberg symptom – increased body sway or falling), the result is evaluated by how long the subject can hold this pose (in seconds).

The Romberg test (the stork position): standing on one leg, the other leg bent at the knee, the foot of the bent leg touches the support leg just above the knee and is slightly turned to the right, arms stretched forward, eyes closed. The test shows an ability to maintain static balance (raising the foot of the supporting leg or when the other foot touches the floor). The result is evaluated by how long the subject can hold this pose (in seconds).

To evaluate dynamic balance, we used the Bench balance test (P. Hartz et al., 1985). The subject makes 4 consecutive 90° turns (left or right) from the initial position on a narrow surface of the bench, the result is evaluated when the subject returns to the initial position (in seconds).

The Yarotskij test: the subject makes continuous head rotations in one direction at a pace of 1 rotation per second. The test evaluates the level of static balance with a constant irritation of the vestibular apparatus. The result is identified by how long the subject can maintain balance (in seconds).

The following math-and-stats methods were used to process the results of the study: to calculate the reliability of the obtained data, we used the Wilcoxon signed rank test, the Mann-Whitney's U-test with a 0.05 level of significance ($p \geq 0.05$). The growth rate of the indices was calculated with the Brody's equation:

$$W = \frac{V2 - V1}{0{,}5x(V1 + V2)} x\,100\% ,$$

where W – growth rate; V1 and V2 – initial and final results in the tests. For each of the studied tests we calculated the arithmetic mean ($\bar{x}$), and mean square deviation (σ)

The research was organized in the Shadrinsk Special (Correctional) Boarding School No 11. The study involved 10-11-year-old schoolchildren, who were divided into two experimental groups (EG-1 and EG-2): the first group included 11 children, the second group – 13.

We have developed a method for development and improvement of coordination abilities of the schoolchildren with hearing loss, the content of which included four blocks of exercises:

I. Exercises with a changing support surface area;

II. Exercises on a small support surface area;

III. Exercises for the vestibular apparatus irritation (semicircular canals);

IV. Exercises performed with eyes closed.

The presented blocks of exercises were included in the program material of classes for 10-11-year-old schoolchildren with hearing loss in both experimental groups, the exercises were mastered sequentially, with gradual complication of the studied material. Two weeks were allotted for learning each block of exercises. A distinctive feature of the classes with EG-1 was the introduction of exercises with fitballs and elements of fitball gymnastics.

The detailed content of the experimental methodology for development and improvement of coordination abilities of 10-11-year-old schoolchildren with hearing loss are presented in table 1.

Table 1

Content of the method for coordination ability development of 10-11-year-old schoolchildren with hearing loss

Content of classes for EG-1	Content of classes for EG-2
I. Exercises with a changing support surface area	
- walking with a fitball; - walking with throwing and catching a fitball; - walking while dribbling a fitball (in a straight line, in a circle, in different directions); - exercises in a following initial position – siting on a fitball, legs wide apart, legs together; - exercises in a following initial position – sitting on a fitball with alternate leg lifts; - rocking and exercises on a fitball in a following initial position – lying on the stomach with support: 2 legs – 2 arms, 1 arm – 1 leg (same and opposite); - rocking and exercises in a following initial position – lying sideways on a fitball with support: 1 arm and 2 legs or the same arm and leg.	- walking along the path (with various objects, stepping over objects); - walking in a circle (in different directions); - walking and stepping over the rails of the gymnastic ladder; - standing on one leg, the other straight forward (sideways, backwards, leg bend); - walking on planks (“bumps”).
II. Exercises on a small support surface area	
- exercises in a following initial position – sitting on an elastic ball; - exercises in a following initial position – sitting with a support on one leg; - exercises in a following initial position – sitting on a fitball without leg support; - exercises in a following initial position – lying on the stomach on the fitball with different arm and leg support.	- walking on a narrow surface with various tasks; - walking, running, jumping, crawling on a tilted surface.
III. Exercises on the vestibular apparatus irritation (semicircular canals)	
- rocking with low and high amplitude in a following initial position – lying on the stomach or on the back on a fitball, sitting on a fitball; - head tilts and turns while rocking simultaneously in a following initial position – sitting on a fitball; - combination of head tilts and turns with bends and turns of the torso in a following initial position – sitting on a fitball.	- eye movements; - head tilts and turns in different planes; - head turns while the torso is tilted; - 90°, 180°, 360° turns (with jumping as well); - forward and backward rolls.
IV. Exercises performed with eyes closed	
- initial position – sitting on a fitball, legs apart; - head tilts and turns in a following initial position – sitting on a fitball; - rocking on a fitball in different positions – sitting, lying on the back or stomach with four support points.	- walking (backwards, with sidesteps, sideways); - circling; - head tilts and turns; - toe stand, on one leg (the same on an elevated support).

Note: EG-1 – experimental group No 1; EG-2 – experimental group No 2

The pedagogical experiment on the introduction of the experimental method for development and improvement of coordination abilities of 10-11-year-old children with hearing loss was conducted during the second school term. The EG-1 children were studying three times a week: sets of exercises on a fitball were introduced in a preparative part of a physical education class, as well as one additional correctional fitball gymnastics class under the adapted educational program. Children from EG-2 visited classes aimed at development of coordination abilities of 10-11-year-old children with hearing loss in the same form and volume, except for the fitball exercises. The conducted sets of exercises did not contradict the thematic planning and sections of the physical education curriculum according to the requirements of the Federal State Educational Standard for schoolchildren with disabilities. During the period of the experiment, the schoolchildren went through the "Gymnastics" section of the curriculum, which provides for development of coordination abilities.

Results and discussion. Before the pedagogical experiment, we have conducted a test to identify the level of coordination ability development. According to the obtained motor test results, there were no significant differences between EG-1 and EG-2, as evidenced in the table 2.

After the experiment, we also conducted a control test, which demonstrated that the EG_1 schoolchildren had significant differences compared to the initial data ($p \leq 0.05$). The EG-2 children have also revealed positive changes in coordination abilities, however the results were not statistically significant ($p \geq 0.05$) (table 2).

Table 2

Development of coordination abilities of 10-11-year-old schoolchildren with hearing loss before and after the experiment

Test	Before		P	After		P
	EG-1	EG-2		EG-1	EG-2	
The Romberg test, classic position, s	14.5±2.6	14.0±1.69	≥0.05	17.75±2,84	15.25±1.8	≤0.05
The Romberg test, stork position, s	10.6±2.11	9.92±1.53	≥0.05	13.5±2.31	11.33±1.67	≤0.05
Bench balance test, s	12.2±1.34	12.25±1.63	≥0.05	10.2±1.12	11.08±1.63	≥0.05
The Yarotskij test, s	20.4±2.36	21.6±2.18	≥0.05	26.6±2.4	23.25±2.2	≤0.05

Note: EG-1 – experimental group No 1; EG-2 – experimental group No 2

We have also calculated the growth rate of the studied indices of both experimental groups that identify the level of coordination abilities of schoolchildren with hearing loss. The obtained results show that the suggested sets of physical exercises have a positive effect on development of coordination abilities of the studied group, but the most effective is the method introduced in EG-1, with fitball exercises. The growth rate indices in EG-1 correspond with average and high levels of changes in the results, while in the EG-2 – with a low level (table 3).

Table 3

The growth rate of coordination abilities of 10-11-year-old schoolchildren with hearing loss after the pedagogical experiment, %

Test	EG-1	EG-2
The Romberg test, classic position	22.41	8.9
The Romberg test, stork position	27.36	13.9
Bench balance test	16.39	9.55
The Yarotskij test	30.39	7.64

Note: EG-1 – experimental group No 1; EG-2 – experimental group No 2

Conclusion. Therefore, results of the conducted study on the introduction of the designed method for development and improvement of coordination abilities of 10-11-year-old schoolchildren with hearing loss have shown that the most effective ways to develop the studied abilities in the studied group include sets of physical exercises, which include fitball exercises and fitball gymnastics elements.

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

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DEVELOPMENT OF STATIC AND DYNAMIC BALANCE OF 11-12-YEAR-OLD SCHOOLCHILDREN WITH INTELLECTUAL DISABILITIES BY MEANS OF OUTDOOR GAMES

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Abstract. The purpose of the study was to develop and experimentally substantiate a method for developing static and dynamic balance in children of secondary school age with intellectual disabilities. The results of the pedagogical experiment proved the effectiveness of the designed method, the content of which included specially selected physical exercises and outdoor games aimed at developing the ability to maintain balance in static poses and when performing motor actions on a narrow support. The growth rate in motor tests revealed a high and average level of the studied indices after the pedagogical experiment.
Keywords: schoolchildren with intellectual disabilities, static and dynamic balance, physical exercises and outdoor games.

Introduction. An ability to maintain posture stability (balance) is a main component of a complex structure of man's motor coordination abilities. Abilities to control movements, learn new motor actions, reconstruct existing motor skills and form physical qualities in accordance with alternating conditions and motor experience require a sufficient level of the musculoskeletal system development. For social and labor adaptation of schoolchildren with intellectual disabilities and graduates of special (correctional) educational institutions, an ability to maintain balance or posture stability for a long time in professionally applied physical exercises of static and dynamic nature is of vital importance [1-3].

An ability to maintain balance in various body positions or when performing motor actions is necessary in any activity of schoolchildren with intellectual disabilities in special (correctional) general education schools: production training, educational and extracurricular events, physical education, health improving and sports activities [4-8].

As the studies show, children and adolescents with intellectual disabilities are significantly behind the normally developing peers in motor tests that determine the level of development of coordination abilities, the balance function in particular. According to the researchers' opinion, this is due to the disorder of integrative brain activity in intellectual disabilities, since the manifestation of coordination abilities is provided by a complex combination of actions of various analyzers: motor, vestibular, auditory, visual, skin, united by the regulatory influence of the central nervous system [1, 2, 9, 10].

The balance function development in the process of adaptive physical education of students of secondary school age with intellectual disabilities helps to improve the technique of existing motor skills and facilitates the mastery of new motor actions in accordance with the content of the "Physical Education" program's subject field [9, 11].

In order to develop the ability to maintain posture stability (balance) during adaptive physical education classes it is necessary to apply both ways and methods associated with the basic movements – walking, running, jumping, throwing, climbing, climbing over, as well as specially selected and modified physical exercises and outdoor games that contribute to the formation of static and dynamic balance of students with intellectual disabilities [1, 3, 9, 11].

The aim of our study – to develop and experimentally justify the methodology of development of static and dynamic balance function in children of middle school age with

intellectual disabilities.

Methods and organization. In this study, we used the following methods: pedagogical testing, pedagogical experiment, math-and-stats methods.

The pedagogical testing was conducted to identify an ability to maintain balance in 11-12-year-old children with intellectual disabilities, we performed the following tests.

The "Sideways (right/left side) bench walk" test was conducted to determine the dynamic balance development. Testing protocol: the subject stands with their right (left) side on the edge of a bench and walks with side steps. Length of the bench – 4 m, height – 20 cm, width – 25 cm. The countdown began with placing the foot on the bench and ended after the subject's descent from the bench. The result was measured in seconds.

The "Backwards bench walk" test was also used to determine the dynamic balance in more complicated conditions. Testing protocol: the subject walks backwards on the bench, arms to the sides, and as quickly as possible. Length of the bench – 4 m, height – 20 cm, width – 25 cm. The countdown began with placing the foot on the bench and ended after the subject's descent from the bench. The result was measured in seconds.

The Tandem Romberg Test was used to identify static balance. Testing protocol: the subject stands, soles of the feet are positioned on the same line, the heel of the right foot touches the toe of the left foot, arms to the sides, eyes closed. The result was determined by how long the subject could hold this pose (in seconds)

The Stork Romberg Test was also used to identify static balance. Testing protocol: the subject takes the initial position – stands on one leg, the other leg bent at the knee, the foot of the bent leg touches the knee of the other, arms stretched forward, eyes closed. The result was determined by how long the subject could hold this pose (in seconds).

To identify the effectiveness of the designed method for the development of balance function, we have carried out a 3-month pedagogical experiment in the Shadrinsk Special (Correctional) Boarding School No 11 for children of middle school age with intellectual disabilities. The experimental method included specially developed physical exercises and outdoor games aimed at the development to maintain posture stability in conditions of physical education classes.

After the pedagogical testing, the subjects were randomly divided into the experimental and control groups of 12 children each. The sessions were held 2 times a week, 26 sessions in total. The experimental group was training according to the designed method for the balance function development, the control group – according to a special (correctional) school program in compliance with the Federal State Educational Standard for Education of Schoolchildren with Mental Retardation (Intellectual Disabilities, Variant 1).

The statistical data processing of the pedagogical testing and experiment ds was done in Microsoft Excel, Statistica 13.0. The significance of differences was assessed with the Student's T-test, normality of distribution was identified with the Shapiro-Wilk test. The data are presented in a form of arithmetic mean and mean square deviation, the growth rate was calculated with the Brody's equation.

Results and discussion. Before the pedagogical experiment, there were no significant differences in the performance of motor tests reflecting the balance function development (table 1).

The results of the pedagogical experiment have shown that the experimental group children had positive changes in the studied indices compared to the initial data ($p \leq 0.05$) (table 2).

Moreover, the growth rate results also reflect an effective influence of special physical exercises and outdoor games included in the experimental method aimed towards the static and dynamic balance development (table 3).

Table 1

Balance function development of 11-12-year-old children with intellectual disabilities before the pedagogical experiment

№	Test	Experimental group (n=12)	Control group (n=12)
1	“Sideways bench walk” test, left side, s	5.2±1.8	5.1±2.1
2	“Sideways bench walk” test, right side, s	5.7±1.7	5.5±2.0
3	“Backwards bench walk” test, s	4.2±1.5	4.1±1.8
4	Tandem Romberg Test, s	18.9±6.2	20.3±6.3
5	Stork Romberg Test, s	9.3±4.3	9.1±4.5

Table 2

Development of the ability to maintain balance in 11-12-year-old children with intellectual disabilities after the pedagogical experiment

№	Test	Experimental group (n=12)	Control group (n=12)
1	“Sideways bench walk” test, left side, s	3.3±0.7*	4.8±2.6
2	“Sideways bench walk” test, right side, s	3.8±0.8*	5.2±2.1
3	“Backwards bench walk” test, s	2.8±0.8*	4.0±1.5
4	Tandem Romberg Test, s	27.4±6.4*	21.1±4.9
5	Stork Romberg Test, s	15.9±4.9*	9.0±4.5

Note: * – significance of difference between the studied indices after the experiment ($p \leq 0.05$)

Table 3

Growth rates of the balance function development indices in 11-12-year-old children with intellectual disabilities, %

№	Test	Experimental group (n=12)	Control group (n=12)
1	“Sideways bench walk” test, left side, s	45.5	2.0
2	“Sideways bench walk” test, right side, s	45.8	5.3
3	“Backwards bench walk” test, s	36.8	2.2
4	Tandem Romberg Test, s	38.5	3.4
5	Stork Romberg Test, s	54.8	4.2

The experimental method was the most effective in the static balance test. After the Stork Romberg Test, we discovered significant changes ($p \leq 0.5$): time of holding the pose in the experimental group has changed from 9.3 seconds at the beginning of the experiment to 15.9 seconds after the experiment. The growth rate amounted to 54.8%. The control group showed insignificant changes in the absolute values of this test: 9.1 seconds before the experiment and 9.0 seconds after the experiment. The growth rate of the studied index in the control group was 4.2%.

In the Tandem Romberg Test, which also reflects the level of static balance development, the experimental group has shown significant changes in the results after the experimental method's introduction: from 18.9 seconds to 27.4 seconds. The growth rate in the experimental group was 38.5%. The control group also demonstrated positive changes in the indices of this test, but they were insignificant, as evidenced by the growth rate of 3.4%.

Significant ($p \leq 0.5$) positive changes were also found in the "Sideways bench walk" test (right side) in the experimental group after the pedagogical experiment. The time of performance has changed from 5.2 seconds at the beginning to 3.3 seconds after the experiment. The growth rate of this task amounted to 45.5% in the experimental group. In the control group, insignificant changes in the absolute values were revealed from 5.1 seconds at the beginning to 4.8 seconds after the experiment. The growth rate in the control group was 2%.

The same tendency was revealed on a significant level ($p \leq 0.5$) in the "Sideways bench walk" test (left side) that evaluated an ability to maintain balance while moving on a narrow support. The result in the experimental group before the test was 5.7 seconds, after the test – 3.8 seconds, as also evidenced by the growth rate – 45.8%. In the control group, we have found insignificant changes: 5.5 seconds before the experiment and 5.2 seconds after the experiment, the growth rate – 5.3%.

In our opinion, such significant positive changes in absolute values before and after the experiment are due to the accessibility of the content and performance of the proposed control tasks and the selection of special physical exercises and outdoor games aimed at the development and improvement of the studied motor abilities.

We have also found significant changes in the indices of the "Backwards bench walk" test ($p \leq 0.5$): in the experimental group, the performance time before the experiment was 4.2 seconds, after – 2.8 seconds, the growth rate in this test was 36.8%. The control group has demonstrated insignificant changes in the absolute values of the studied ability: 4.1 seconds before the experiment and 4.0 seconds after, the growth rate was 2.2% (table 3).

Conclusion. Therefore, the designed experimental method for the balance function development in 11-12-year-old schoolchildren with intellectual disabilities had a positive effect on the development of static and dynamic balance. High growth rates of the studied indices were revealed in the tests reflecting the level of static balance development: Stork Romberg Test – 54.8%. Average growth rates were observed in the following tests: "Sideways bench walk" test (right/left side) – 45.5% and 45.8%, respectively, "Backwards bench walk" test – 36.8%. The growth rate indices in the Tandem Romberg test – 38.5% – also corresponded to the average level.

The obtained results of the pedagogical experiment prove the effectiveness of the designed experimental method for the development of static and dynamic balance of 11-12-year-old children with intellectual disabilities studying in special (correctional) schools and correctional classes of general education schools.

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HAS MODERN SPORTS SCIENCE OVERCOME THE SAGAN EFFECT?

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Abstract. There has long been a view in the scientific community that scientists have a responsibility to foster greater interaction between science and society. Even though many scientists are actively involved in public life, a portion of the scientific community still expresses concern about the Sagan effect. Objective: to analyze the literature on the impact of the Sagan effect on the scientific performance of sports university employees. This study was conducted according to the PRISMA-S and PRESS literature search checklists. The literature search was conducted in PubMed, Google Scholar, Elibrary and Epistemonikos. The time frame of the search was 10 years. The search identified 13 references. The search did not identify any eligible studies that met our preselected inclusion criteria. In addition to examining the Sagan effect as a professional stigmatization of scientists, a more in-depth study of public bias towards scientists who present scientific knowledge to a wider audience is warranted.
Keywords: Sagan effect, sports science, PR projects, advertising, information projects, sports management.

Introduction. In 1991, an American astronomer and science communicator Carl Sagan was nominated for membership in the National Academy of Sciences. Despite the effort of some strong supporters, including the Nobel Prize winner Stanley Miller, who argued passionately for Sagan's admission to the Academy, the nomination failed. Sagan was eliminated on the first voting round, resulting in a full debate and vote by the Academy members. He then received less than 50% of the affirmative votes in the final round, a far cry from the two-thirds required for admission. Sagan's biographers argue that Sagan's rejection by the Academy and Harward's prior rejection of this tenure were a direct consequence come to be known as the "Sagan Effect": popular, visible scholars are worse academicians than those who do not participate in public discourse [1]. Later on, Sean Carroll, a science writer and freelance researcher of the California Institute of Technology, wrote a popular blog post wittily titled "How To Get Tenure at a Major Research University", drawing in part on his own failed attempt to get tenure at the University of Chicago [2]. He gave 13 pieces of advice, about half of which are straightforward and even obvious: "Do good research", "Make an impact in the field", "Bring in grant money". The others mostly do not make sense: "Don't be too well known outside the field", "Don't write a book", "Choose your hobbies wisely". Carroll argued that scientists are suspicious of colleagues who have too high a public status. Not out of envy, but because there are concerned that public scientists care more about their media presence than their findings. According to this point of view, the ideal researcher devotes themselves exclusively to the search for knowledge and related work in the laboratory, without outside interference. However, this common belief has been repeatedly questioned in a number of studies aimed at quantifying the academic performance of scientists (number of articles published by them since the beginning of their career, average number of publications per year and number of citations received (i.e. Hirsch index, etc.)). The fact that scientists who interacted with society were actually more academically active than the average scientist was a surprising finding. Rather, greater activity in publicizing scientific information was correlated with higher performance and vice versa, inactivity in science popularization was correlated with lower performance [2]. The most active communicators tend to be the more experienced scientists, which are particularly

visible in the media [4]. Perhaps this is the reason why the Sagan effect is irrelevant for modern astronomers. A global survey of astronomers conducted by Marta Entradas and Martin Bauer and published in Nature Astronomy shows a picture of a scientific community most of whose members are enthusiastically involved in public communication, with 87% of astronomers regularly participating in public events and media activities, and half of them taking part in at least 9 such events per year [5]. Also, a recent study on scientists‘ social media activity found a positive correlation between scientists' participation in scientific discussions on social media and an increase in their citations [6]. And what is happening in sports science right now? Do public scientists really show a lack of effectiveness in scientific work? If not, has the modern academic environment overcome the Sagan effect? Taking into account the analysis of the problem, data of modern scientific literature and requests of sports university employees, the objective of the study was identified.

Objective: to analyze the literature on the impact of the Sagan effect on the scientific performance of sports university employees.

Methods and organization. The study took place at the Department of Sports Medicine, Russian University of Sport "GTSOLIFK", Moscow. This study was conducted according to the PRISMA-S [7] and PRESS (Peer Review of Electronic Search Strategies) literature search checklists [8]. The literature search was conducted in PubMed, Google Scholar, Elibrary and Epistemonikos with the following keywords: "Sagan effect" AND (sport OR "physical culture"). The time frame of the search was 10 years. No language barrier was set in this study and no research design restrictions were applied in the search.

Results and discussion. The search identified 13 references (Pubmed=0, Scholar Google=13, Elibrary=0, Epistemonikos=0). The search did not identify any eligible studies that met our preselected inclusion criteria. Therefore, there is currently no direct evidence of the influence of the Sagan effect on the scientific performance of sports university employees. However, contrary to the increasing relevance of scientific collaboration, there still seems to be a prevailing bias among researchers that social engagement may have a negative impact on their scientific credibility and professional development. In a recent study, Chen et al [9] confirmed the existence of the Sagan effect based on a nationwide survey of 8 533 scientists. The observed effect was a consequence of negative experience that indirectly influenced the development of individual behavioral norms by suppressing the researchers' desire to present the results of their research to the wider audience. Today, most scientists have no experience communicating via social media or blogs. Meanwhile, young scientists are more adept at using new media tools and therefore may be in a better position to interact with an audience that is increasingly seeking scientific data online [10]. The development of social media has led to a shift in the way scientists approach awareness-raining activity, revealing discrepancies between traditional communication channels and new platforms. Although social media gives scientists more control over the content [11], this may lead to a so-called "public relations nightmare", which in turn can have a negative impact on public trust and perceptions of the scientific activity's legitimacy [12]. Thus, an in-depth study is highly relevant in the context of social media. Rodder in her study from 2012 [13] identified the reasons for the ambiguous attitude of the academic environment to scientific communication, outlining the factors that determine whether it is acceptable or unacceptable to popularize it. Having analyzed 55 interviews with leading and young researchers involved in human genome projects in four countries, the author concluded that the scientific community recognizes a scientist's publicity as acceptable only if three conditions are met:

1. Scientific contribution credibility: the research must be credible;

2. Reference to institutional role: public visibility is expected from heads of institutes or presidents of large academic communities;

3. Passive nature of interaction with the media: visibility is acceptable if journalists

approach the scientists, not if the scientist initiates it.

Consequently, the academia tolerates and, if the aforementioned conditions are met, even encourages interaction with the press [14]. The discussion raised requires a pragmatic, business thinking approach. Techniques for creating public visibility of an individual (a scientist in our case) and promotion in the information space of scientific projects, programs, events and organizations are developed, tested and implemented on the basis of audience requests, requirements and wishes of scientific technology customers, as well as on the basis of problems requiring their solution (including the prompt ones) [15]. Specialists who promote a scientific project or a scientific figure do not act for the sake of their presence in the "information space". Publicity of a scientist, their presentation and self-advertisement (their status, services and projects) should be considered and used as tools for solving numerous topical field and state tasks and issues. Sports science specialists, their projects, methods and research data are a product of scientific activity. They are subject to the same requirements as any other type of product and utilize universal principles of promotion via PR (public relations) and advertising. Lack of participation channels, time, energy, funding, skills and institutional support (e.g. incentive mechanisms, policies and training) has been identified as major obstacles for scientists' participation in public work [16].

Before implementation of comprehensive PR projects of scientific organizations and societies, the managers do the following:

– conduct research on the needs of different audiences in science or the needs of the scientific product's "customer";

– take into account trends in the information services and event management markets, advertising and communication industries;

– use data from STEP analysis that examines various processes of society to identify the needs of different audiences and institutions;

– rely on data on the competitive environment, its strengths and weaknesses in its activity, which are obtained in the SWOT analysis;

– choose traditional and develop innovative marketing strategies for selling the scientific product, branding tools for scientists and scientific organizations.

All of these actions allow choosing a proper "roadmap" for realizing the set tasks and solving problems related with science, scientific knowledge and an individual acting in the scientific "field". Meanwhile, active informational policy and demanded PR-projects of scientific organizations and their representatives (scientists, specialists) allow:

– scientific organizations and scientific communities to attract additional funding (grant money from different foundations, sponsors, patrons, advertisers);

– scientific environment representatives to receive additional income due to their involvement as experts in various media, master class speakers at the request of organizations, lecturers of commercial, professional development and retraining courses.

A subject of science (an individual or a community), which status, experience, technologies are consistently and properly positioned and advertised (and therefore it is more visible in the information space), does not only create publicity for itself, but also inspires more trust, more often and more strongly stimulates the "feedback" reception, is more quickly remembered, forms a positive attitude towards itself, i.e. in essence, becomes a brand. By taking advantage of fame, positive image and reputation, it allows to receive more preferences, to "sell" scientific knowledge (we are talking about an active form of science popularization) and scientific products (technologies, methods, marketing data and scientific data for marketing, scientific events, etc.). However, branding and advertising in science are complicated due to the lack of resources: personnel, methodological, informational and financial. The lack of budget for active information support and PR support of scientific activity (with the involvement of scientists as well), inactivity of scientists and their organizations in terms of implementing

media projects leads to the fact that:

1. significant achievements of science, topical events, outstanding projects do not attract the attention of the public, media, potential partners, are unnoticed or lost in the media, which is characterized today by "information noise", the presence of a lot of "rubbish data", intense competition between events of different industries for audience and media attention, which distract attention from science and the results of its activity;

2. status of professional scientific activity is not validated in the information space by the facts of success, scientific activity is not positioned among the young (potentially ready for involvement in scientific activity) as demanded, trendy, interesting and profitable in society and in various spheres of life (including physical culture and sports);

3. pseudo-scientists, pseudo-scientific projects and superficial scientific data flood the information public space, which leads to a decrease in the level of education of society and its individual groups, to the undermining of the authority of fundamental science and the authority of the scientist;

4. a number of public/media scientists who are "headliners" of scientific projects and brands (and therefore ambassadors and "advertising faces" of science) is not growing, which, in turn, reduces a number of "imitators" of their information activity among future or young scientists;

5. in the competitive war to attract additional funding, the scientific organizations are "invisible" to potential commercial partners, who could consider science as a platform to promote their brands and advertise their services and products, and scientists as individuals who recommend them.

Technological and informational revolution, rapid development of digital technologies predetermines the need to create and promote information content. It is necessary to increase the volume and number of content formats about science and its representatives. This is facilitated by an increase in the number of information projects on various platforms:

– columns and podcasts on organizations' websites and industry, cross-field and mass-oriented internet portals;

– author's blogs and channels in social media and popular messengers;

– author's vlogs of scientists and video projects (documentaries, interviews, etc.) of organizations on video platforms;

– information products created and promoted in the media field in cooperation with the media, blogosphere representative and video hosting services

In turn, this change:

– increases requirements in the level of creativity of managers and scientists who popularize science;

– causes a need to create and promote original or popular content among various target groups, which, in conditions of "clip thinking", predisposition to "superficial way of thinking" and short-term information consumption, should be non-trivial, viral and interactive;

– makes quite serious demands on such scientist competences as: public speaking and acting skills; presentability (appearance, non-verbal ways to present information, communication with and influence on audiences); mental stability when "filming" – in interaction with different audiences in TV broadcasts and online conferences, when filming vlogs; teaching and presenting skills at public events (conferences, master classes, etc.); skills to write and eye-catching and selling text.

An increase in "media weight" (the amount of information accumulated through active informational policy, advertising and presentation campaigns, media projects, quickly found in the information space) and high-quality communicative activities of the subjects of science:

– increases the level of trust on the part of consumers and structures interested in solving their own tasks in and by means of science;

– allows to "step out of the competition" and become public opinion leaders;

– helps to overcome "obstacles" (mental, organizational, bureaucratic) more quickly when broadcasting their content, implementing scientific projects and selling scientific products;

– contributes to the rapid identification of active audience and important individuals interested in science, as well as the rapid creation and increase of the target audience's "core", involving it and its communication representatives on the topic of scientific knowledge, motivating it to receive, acquire scientific knowledge and request scientific data;

– causes the occurrence and strengthening of healthy competition between scientific schools, organizations and scientists, which leads to the development of scientific activity, the emergence of innovational and creative solutions in terms of promoting science as a demanded sphere of life.

Speaking about the existing opinions (commonly found in the business environment and the information space) regarding the fact that a media scientist or a media scientific community is less effective in the scientific field, we would like to note that they:

– are not a problem or a "mental brake" for scientific project managers and organizations, where active marketing and entrepreneurial activity take place;

– have formed, become a cultivated stereotype and "live" in subsidized scientific projects, where the receipt of proper resources for scientific activity is guaranteed and does not require promotion in a competitive environment;

– are supported by scientists who have obtained the proper status and well-being in their time, but are "afraid" and cannot withstand competition from the new generation of hyperactive and ageing, but advanced in terms of new technologies, scientists who successfully apply modern ways and relevant formats of promotion in the information space.

What we need today are programs for scientific projects and organizations that "nurture" their own presenters, opinion leaders and scientific representatives. They should take "burden" of science promoting and popularization from those scientists who, for various reasons, cannot or do not won to be public and are not ready to engage in the implementation of marketing programs, information projects, in building a personal brand aimed at wider audience. Programs are needed to promote a positive image of a scientist (a young scientist as well) to create a trend for scientific activity, to prove the prestige of scientific specialties, to demonstrate the applied value of scientific research and data for practice. For example, in the activity system of universities and scientific project organizing committees it is necessary to increase the amount of content (news, "selling", informative), which is prepared and distributed by specialized departments responsible for PR and service sales. Such departments should develop a content plan that includes the production and promotion of content about science and scientists who demonstrate their effective performance and achieve success (in science, in commercial activity related to science product sales). Universities should provide advertising modules for science projects in their printed and electronic presentation and advertising products, in journals and collections of scientific and methodological materials. To form scientific potential in the personnel and increase the number of young people engaged in science, it is recommended to delegate to student scientific societies the authority to provide active information support of the scientific life in the university. It is important to involve students from various university departments who are training in PR, advertising, marketing, journalism, event organization, preparing for academic and extracurricular internships based on scientific projects, organization and events to promote science and scientists. We can also note a demand for the implementation of additional long-term educational programs and local projects (courses, practical classes, master classes, methodological materials) that help to improve the skills of scientists in presenting and advertising themselves and/or their organizations and projects in the information space. Status, positive reputation, image of a scientist, their brand, their successful activity can be used in the advertising of universities and scientific organizations, events (films, videos, e-presentations, booklets, billboards on the university's territory, etc.) in the social media content (interviews, thematic expert opinions, author's

thematic section, etc.) These ways of promoting scientists and scientific knowledge influence both the "internal environment" of a scientific or educational organization (motivation of students and personnel to enroll in the master and post-graduate programs, their entry into scientific communities and participation in the scientific grant implementation, etc.) and the "external environment" (attracting attention of the media, grant founders, scientific product customers, etc.). It is necessary to utilize the resources of specialized media studios and media teams operating in universities and capable of creating:

– content that requires preliminary preparation and long processing (video sections, studio programs, talk shows, etc.);

– "fast" content (live streams, broadcasts, reports, reviews, interviews).

The events within the framework of which the brand of public/media scientists is formed and established include contests with various nominations on the science topic. Today, there is a need to increase the award options with original nominations: nominations for young scientists and for media scientists who implement media projects. The format of scientific conferences which are often held in an "academic" format and are not able to raise interest and motivate young people to join the rank of scientists, do not "produce" content that is worthy of active distribution in the information space also requires reimagining. It should be noted that this systematic approach to promoting scientists in the information space is logical and has a reason for implementation where:

– there is a culture of correct and loyal attitude to media scientists on the part of the scientific business community;

– marketing processes are set up and active entrepreneurial activities are carried out in the scientific field;

– an association of active media scientists has formed, proving the right to "exist" by the fact of creating information projects and results of their success (number of subscribers, views and reposts; a number and level of partner collaborations; involvement of industry and federal media in information projects, etc.).

A significant role in solving these problems and eliminating the issues associated with the tense relations between the new and "classic" scientists should be played by management personnel – specialists in the field of advertising, PR, and digital technologies, who should:

– propose algorithms for maintaining a certain balance in terms of the expenditure of scientists' personal resources on their professional activities and work in the media, allowing them to concentrate on their professional activities;

– provide comprehensive and long-term or prompt situational PR support for scientists' activities and the process of promoting scientific knowledge;

– develop solutions to stimulate scientists' activity in the media.

Conclusion. In conclusion, we did not find any suitable studies, hence, there is currently no direct evidence of the influence of the Sagan effect on the scientific performance of sport university employees. As academic sports institutes and universities focus too much on the "publish or die" game, this type of activity becomes the second most important (after research itself) for today's scientists. Unfortunately, this results in research and publication becoming the first priority, with public outreach and engagement taking only a minor place in the evaluation of scientists' performance [17]. However, most scientists understand and value the importance of communicating with the public [18-20]. Many of them believe that interacting with the media is not just desirable, but even essential for any researcher. It is a great opportunity to share one's findings with the world and contribute to the scientific literacy of society [14]. Despite this, there is concern that popularizing science may be at odds with a successful academic career, particularly for young scientists and post-graduate student. We suggest that universities should develop and implement comprehensive policies to minimize the Sagan effect in all areas of university activity. Scientific discoveries lose their value if they

remain unknown to the public. Scientists need to improve communication with the public in order to play an active role in relevant public debates. In addition to examining the Sagan effect as a professional stigmatization of scientists who present scientific knowledge to a wider audience, a more in-depth study of public bias towards such scientists is warranted. Analyzing public bias would identify and expand the range of possible stigma, encompassing both professional and public/social aspects. Further research in this area is required.

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MOTOR CULTURE OF THE RURAL COMMUNITY OF BELARUS: FACTORS, CONDITIONS, PATTERNS

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Abstract. The article presents a theoretical and practical substantiation of the system of factors, conditions and patterns of the motor culture of an individual – an active subject of the rural school educational space, who is a representative of the majority of social and professional communities of rural regions in the Republic of Belarus. Aim of the study: development and theoretical substantiation of the factors, conditions and patterns of the individual motor culture in the educational environment of rural schools in Belarus. The pedagogical technology for the formation of the individual motor culture is substantiated, which is innovative and relevant, as it meets the factors, conditions and patterns of the socio-pedagogical and socio-economic situation of comprehensive institutions in rural regions of the Republic of Belarus.
Keywords: individual motor culture, social and professional communities of rural areas.

Introduction. The modern world community is currently at an important cultural and historical stage of anthroposociogenesis, when along with scientific and technical, information and communication progress, health-promoting motor and cultural traditions relevant for many previous generations are rapidly being lost, and, most importantly, no new ones are being acquired [1-7]. This state of affairs aggravates the problem of motor and cultural content of a modern person's daily routine, regardless of their belonging to any ethnic, social or professional community, be it Anglo-Saxon or Hindu, urban or rural, service or industrial workers [8-12]. Hypokinesia (Geek *ὑπό* – "under"; *κίνησις* – "movement"), considered as a spontaneous limitation of movement duration and intensity by an individual, leading to a decrease in the level of motor activity and, as a consequence, the physical condition of the body, is rapidly progressing in the modern world community. This already directly threatens the homeostasis preservation in the human population in many developed countries, when the 'movement is life' phrase begins to be interpreted not in a hypothetical, but in a literal sense.

Methods and organization. The relevance of our study is dictated by the issues outlined by the lifestyle hypokinesia of the modern rural community in the Republic of Belarus (the last stand of modern and cultural relics in anthroposociogenesis), cultural, economic and demographic contradictions:

– firstly, an increasing rate and prevalence of "motor anti-culture" in a lifestyle of many rural community representatives on the one hand, on the other hand – available scientifically-based knowledge (available, but not demanded) on the biological need to provide the body with rational daily motor and cultural activity, as the main base of health culture;

– secondly, the technological progress of agricultural production, which has caused hypokinesia and hypodynamization of most types of labor activity and an increase in free type of modern rural residents on the one hand, on the other hand – low level of motor culture in labor and leisure fields of activity among the majority of modern rural community representatives;

– thirdly, insufficient satisfaction of social expectations of the population in the field of education and physical culture, associated with pedagogical inactivity (limitations) in rural educational institutions on the one hand, on the other hand – a necessity to expand their multifunctionality in the provision of general and additional educational services (since a

number of other candidates for the role of motor and cultural centers with similar pedagogical potential in rural areas is insufficient in most cases);

– fourthly, the rapid progressive development of the internet, which has simplified the universal coverage of the population in assessing information on the culture of movement, nutrition, body and health through modern mass communication means (mobile gadgets (phones, smartphones, tablets, netbooks, laptops), personal computers, TVs, etc.), widespread and actively used by the rural communities on the one hand, on the other hand – low motivation to gain knowledge in forming cognitive sphere of the individual motor culture as the base of a healthy lifestyle and the insufficient information technology culture in the rural community;

– fifthly, an increasing tendency in the world (including Belarus) over the last 50 years of staying behind the average life expectancy among rural community representatives compared to urban ones by 7±2.34 years on the one hand, on the other hand – presence of more ecologically and valeologically preferable living conditions with equal accessibility to medical services in rural areas.

In whole, on the one hand, motor demands of the modern comfortable biogeosociocenosis adapted by a human do not require a wide spectrum and volume of movements. On the other hand, lifestyle hypokinesia affects human health, demanding compliance with certain life conditions associated with holding a proper static and dynamic posture, applied in working positions in the process of labor at a table, machine, conveyor, in the cabin of a car or a mechanical equipment, etc. For such purposes, the myofascial system effectively operating through various dynamic and static movements in everyday life is needed.

Therefore, the poverty of modern biogeosociocenosis on motor and activity requirements does not free a person, but on the contrary demands a certain level of physical development, which is necessary for preserving their homeostasis. This makes relevant not only the inclusion of physical exercise in a person's motor activity according to the specifics of their education or employment (as well as individual physical features) as professionally applied physical culture, but, first of all, the discrete arrangement of various life activities, providing health-preserving static and dynamic balance of the myofascial and musculoskeletal systems as a whole.

At this stage of cultural and historical development of modern society, many countries face a task to provide their citizens a full-fledged motor and cultural replacement of the already lost active types, motor and cultural performance of the hypodynamic daily activities that have come into their place. Since the problem is becoming more and more relevant for the modern rural community, the introduction of motor and cultural health-forming pedagogical technology into the educational process of comprehensive schools in rural areas of Belarus may solve it more efficiently rather than attraction of other subjects of socio-economic infrastructure in rural regions.

Results and discussion. As a result, we have established the patterns of motor culture formation in postnatal human ontogenesis (in the process of creative self-realization in social and professional activity), which are associated with various nature-environmental, socio-economic, cultural-ethnic, educational, pedagogical and other factors that determine nature-environmental and artificial-environmental conditions of biogeosociocenosis of a rural lifestyle (factor → condition → pattern). Their list, characteristics and description are shown below.

A system of factors, conditions and patterns of forming the individual motor culture in the rural community:

1. Nature-environmental:

– factor – positive effect of natural environment that preserved a relict basis of a human everyday lifestyle;

– condition – direct interaction with flora and fauna of rural biocenosis;

– pattern – effective arrangement of health-preserving individual motor activity is possible in maximal application of various

means that have environmentally natural potential of a rural area.

2. Cultural-ethnic:

– factor – strong traditions of compatriotism, family life and social openness of the rural community living for a long time on the same territory, established over many decades;

– condition – high individual and social mutual responsibility of an individual un a rural community;

– pattern – high level of preservation of motor and cultural traditions in rural population is conditioned by the continuity of sociocultural modification of motor and activity sphere of villagers between generations by means of family, social and general pedagogy.

3. Culture-behavioral:

– factor – loss of cultural and behavioral traditions and, as a consequence, low level of lifestyle culture of the majority of representatives of the modern rural community;

– condition – everyday interaction of a person in ontogenesis with asocial environment characterized by a rather high level of hypodynamic (76.3%), food (41.8%), nicotine (38.4%) and alcohol (23.9%) addictions of the adult population;

– pattern – formation of motor, food, body and valeological culture as components of a healthy lifestyle of rural population is based on the principle of positive-negative contrast of positive and negative examples actually present in everyday life activity.

4. Valeology-demographic:

– factor – a pronounced trend over the last five decades of continuous growth of primary disability at working age, with negative demographics and reduced life expectancy among the rural population in comparison with similar indicators for urban residents;

– condition – the impact of negative health-destroying socio-economic environment on rural residents who are in a pre-illness state (not yet sick, but are already not healthy);

– pattern – formation of the individual motor culture in rural communities is ensured by the preventive nature of socio-pedagogical measures hindering the development of illnesses most typical for rural areas, and the organization of movement regimes of rural residents is carried out on the basis of an individual approach, taking into account the specifics of their health condition.

5. Socio-pedagogical:

– factor – low level of motor and cultural replacement of lost motor activity in household, labor, educational and leisure activities of the modern rural community;

– condition – comfortable hypokinesizing subject environment due to the high quality of socio-economic infrastructure in rural areas and substitution of physical labor by mechanized labor;

– pattern – compensation of the lack of motor activity in the lifestyle of rural residents by additional multidisciplinary educational services of rural educational institutions of motor-simulation content.

6. Traditionally-educational:

– factor – civilizational and historical formation of socio-educational status of rural school as a leading cultural and pedagogical center (with the necessary personnel potential) in the formation of motor culture of the rural community;

– condition – open socio-partner interpersonal relations of the subjects of the rural school educational space;

– pattern – movement education of an individual in the rural community is carried out on the basis of involvement of representatives of the circle of educationally motivated social partners (family, bosses and interested organizations).

7. Resource-educational:

– factor – pedagogical inactivity and insufficient multifunctionality in the provision of educational services by rural schools in the arrangement of motor and cultural leisure activities for rural residents without a competitive environment;

– condition – non-alternative and leisure limited range of free (as well as paid) motor and cultural educational services;

– pattern – meeting expectations in the field of physical culture requires the expansion of proposals for the arrangement of free time for

the subjects of the rural school educational space by means of motor and cultural education of an individual.

These factors in the last 20 years are the reason for reduced motor activity of rural residents by 39.6%, physical fitness – by 28.8%, functional state – by 33.4% and require revision of the education system organization in rural areas of the Belarus, when the basis will be the creation of multi-disciplinary socio-pedagogical conditions of the rural school educational space for differentiated formation of the individual motor culture in children and adult communities in relation to each social and age group.

Taking the aforementioned into account, we have developed, tested and introduced the pedagogical technology of forming the individual motor culture in the rural areas of Belarus. We have created main pedagogical conditions for its implementation in 23 rural educational institutions in Brest, Grodno and Minsk Oblasts as an integral socio-pedagogical system, constructed on a direct reverse-educational interaction of an equal socio-pedagogical triad: teachers and schoolchildren, as well as their immediate social environment (parents and other relatives of children, fellow villagers, bosses, etc.).

The developed pedagogical technology of forming the individual motor culture consists of a four-component conceptual model, which includes:

– a target component, revealing the general goal in the formation of the individual motor culture in the rural community as the basis of health-promoting motor activity of the subjects of the rural school educational space;

– a theoretical and methodological component, defining methodological approaches and theoretical foundations of the system of formation of the individual motor culture in a rural community as a subject of the rural school educational space;

– a didactic component, representing the didactic system of formation of the individual motor culture in the conditions of the rural school educational space: means, methods, forms, allowing to obtain the planned result of directed pedagogical activity;

– a resultant component [13], containing criteria and indicators characterizing the level of fitness for cultural motor activity as the basis of health and active longevity of a person in the rural community formed in the subjects of the rural school educational space.

The key condition for the technology implementation was the relevance of considering the phenomenon of motor culture in the modern rural community from cultural and anthropological positions, when motor and body education acts as a reverse-educational (mutually balanced) process of realizing the laws of social and motor experience transmission by older generations to younger ones and (or) vice versa. This process is based on the following general pedagogy components:

– social (the impact of the social environment on the upbringing and formation of the individual in the implementation of its ontogenetic development program);

– age-related (realization of educational and pedagogical activity within different age groups: preschool, school, higher school pedagogy, adult pedagogy, pedagogy of the third age (geragogy – knowledge and skills transfer to people of elderly and old age)).

Implementation of the technology assumes a certain organizational and methodological stage structure in the educational institution:

– at the first stage we implement the method of complex assessment of the individual motor culture according to pedagogical diagnosis of its physical condition and motor-behavioral sphere;

– at the second stage – the methodology of formation of motor and cultural literacy of personality in the rural school educational space as a basis for a healthy lifestyle;

– at the third stage – the methodology of individualization of the individual motor regime in the rural community.

The technology's effectiveness, presented as a pedagogical innovation in 23 educational institutions of rural areas in Belarus, is confirmed with high efficiency according to the assessment criteria of introducing the technology according to the following components [14, 15]:

– educational and enlightening – showed a

positive increase in the assessment of students' knowledge in the field of forming motor culture and healthy lifestyle according to the results of theoretical tests by 68.43%;

– motivation-targeted – demonstrated a positive increase in the number of subjects of the rural school educational space, consciously and purposefully engaged in the formation of motor culture by 3.27 times;

– activity-technological – revealed an improvement in the quality of possession of technological algorithms for forming human motor culture in terms of maintaining correct posture by 43.29%, rationality of locomotor and manipulative activity by 28.44%, and the volume of motor activity by 91.45%;

– bodily-aesthetic – showed an improvement of somatoscopy indicators, indicating the cultural and aesthetic well-being of rural residents' well-being by 46.83%;

– motor-behavioral – revealed a positive increase in the data of the level of motor skill culture of the majority of subjects of the rural school educational space on the basis of pedagogical motor tests by 29.94%, physical conditioning – by 28.48% and calculated data of functional indices by 31.86%; increase in the educational institution attendance of (by 11.43%) due to a decrease in the number of absences due to illness and, as a consequence, an increase in the quality of knowledge of rural schoolchildren by 12.31%; increase in the estimated duration of active life of elderly people in rural areas (by results of an increasing level of everyday motor activity and physical condition of the subjects) by 33.62%.

Conclusion. The abovementioned allows us to mention the possibility of wider application of pedagogical technology of formation of the individual motor culture in social and professional communities not only in rural areas, but also in cities of Belarus.

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

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