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# Quality of Life in Patients After Hip Arthroplasty

## Jakość życia chorych po endoprotezoplastyce stawu biodrowego

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### SUMMARY

**Aim:** The aim of this study was to assess the efficacy of rehabilitation after hip arthroplasty and compare the quality of life in patients before and after surgery.

**Material and Methods:** A total of 30 patients after hip arthroplasty were examined at the ConcordiaSalus Inpatient Rehabilitation Centre in Osieczek. Study patients participated in a physical therapy and rehabilitation programme, which included kinesiotherapy, massage and physical therapy procedures. A 28-question survey questionnaire was used as a research tool.

**Results:** 1. Pain severity in patients after hip arthroplasty and rehabilitation was lower than that experienced before surgery. 2. Hip arthroplasty visibly improved the quality of life. 3. The postoperative level of physical fitness was considerably higher than the preoperative level of fitness. 4. Patients are happy and satisfied with the effects of hip arthroplasty.

**Conclusions:** Physical therapy and rehabilitation constitute an important and basic part of treatment in patients following hip arthroplasty.

**Key words:** hip osteoarthritis, surgical treatment, rehabilitation

**Słowa kluczowe:** choroba zwyrodnieniowa stawu biodrowego, leczenie operacyjne, rehabilitacja

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### INTRODUCTION

Hip osteoarthritis (HOA) is one of the most common health problems in adults and is increasingly often seen as a civilisation disease. HOA results in a decreased quality of life and limited functioning in social and professional settings [1-5].

Epidemiological studies show that the incidence of osteoarthritis varies across countries. For example, osteoarthritis affects 15% of the population in Finland but only 2% of the population in Sweden, even though these are neighbouring countries. In Poland, approximately 8 million people have been diagnosed with degenerative changes, with 40% suffering from hip osteoarthritis [6-10].

The aetiology of osteoarthritis is multifactorial. Its development is often influenced by various factors, such as old age, manual work, overweight and obesity, significant joint overload, low oestrogen levels and carrying heavy objects. Those risk factors may lead to microinjuries and joint cartilage degradation, which may result in osteoarthritis [6, 8, 9, 11-14].

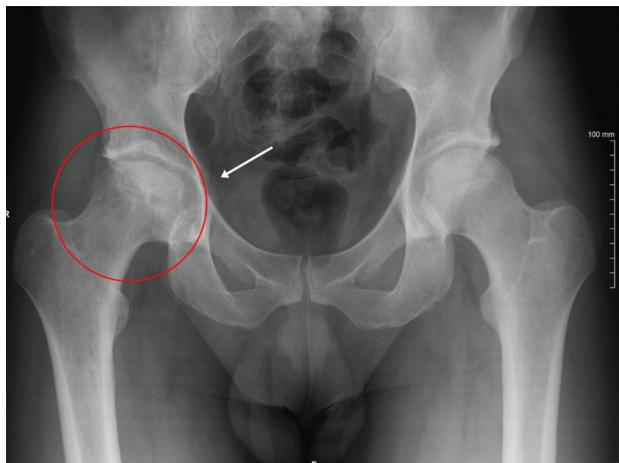
In the initial stage, HOA does not cause many problems, but advanced HOA may hinder even the most basic activities

of daily living. In severe cases, increasing pain and joint mobility limitations cause disability, often making it difficult or impossible for patients to walk. Consequently, patients avoid leaving the house, which in turn means they have fewer opportunities to meet other people. All these factors lead to a drastic worsening of the mental condition of HOA patients. The stress they experience is so strong that it may cause anxiety and depression [15-17].

Radiography is the main imaging procedure used to diagnose HOA. A hip radiograph of an HOA patient shows joint cartilage damage, manifested as joint space narrowing, and increased bone mass in the subchondral layer, with clear osteophytes. Figure 1 presents a radiographic image of a hip joint with evidence of degenerative changes.

Other tools used to diagnose HOA include computed tomography, ultrasound examinations and magnetic resonance imaging [8-10].

HOA treatment should be tailored to each patient individually, taking into consideration their current condition, expectations, age, stage of the disorder and comorbidities. Conservative management is the main method of treatment of this disorder. Everyday exercise, patient education and



**Figure 1.** Radiographic image showing hip osteoarthritis

prevention help increase the quality of life. They may lead to a pain reduction and improve joint mobility.

Advanced cases should be treated surgically with arthroplasty [15-17].

Every patient treated with hip arthroplasty should undergo appropriate rehabilitation, which should be individually adjusted to each case according to the type of endoprosthesis used during the surgery. Rehabilitation programmes also differ depending on age, activity level and comorbidities.

Physical therapy and rehabilitation in patients with coxarthrosis is focused on combatting pain, improving tissue trophism and nutrition, relaxing the periarticular structures, reducing contractures and lowering the increased muscle tone [18-25].

#### PREOPERATIVE PHYSICAL THERAPY

Patients should be appropriately prepared for the arthroplasty procedure.

The main task is to strengthen the limb muscles and maintain the maximum possible ranges of motion in the hip joints. Before surgery, the patient is instructed how to reduce the load on the affected joint, for instance with such orthopaedic aids as crutches or canes. Consequently, patients need to learn to use these aids so that they can correctly load the shoulder girdle and successfully reduce the load on the painful joint.

Appropriate mental and physical preparation for the surgery considerably increases the effectiveness of postoperative rehabilitation. Moreover, such preparation allows for a faster return to physical activity [26-30].

#### POSTOPERATIVE PHYSICAL THERAPY

The entire rehabilitation programme is individually tailored to each patient depending on their condition and motor activity and the surgical method used.

The early postoperative stage takes place in the hospital and lasts approximately a week. Rehabilitation starts on the first day after surgery and includes antithrombotic, cardiovascular and respiratory management.

Standard rehabilitation utilises a CPM splint. The splint allows for passive movement in the hip, which helps restore

physiological joint mobility. The range of motion is set individually and gradually increased every day.

The patient continues with isometric exercise of the gluteal, quadriceps femoris and abdominal muscles. This helps prevent muscle atrophy and improve tissue nutrition.

On the next day, the patient assumes the upright position. It is very important to make sure the walking frame is the correct height and to control and assist the patient.

The following physical therapy procedures are introduced: light therapy, cryotherapy.

Before the patient is discharged from the hospital, they need to learn how to walk up and down the stairs. When walking up the stairs, steps are taken with the healthy leg and then the operated leg and the crutches follow, whereas in order to walk down the stairs, the patient moves the crutches first, then moves the operated leg to the lower step, and then the healthy leg follows. Undergoing gait training with crutches and a walking frame as well as learning correct habits with respect to daily activities is very important before discharge .

With time, the patient is gradually taught how to walk on different surfaces. Gait improvement is extremely important.

Patients return to their usual daily activities within one to two months as they restore their muscle strength and the necessary range of motion.

#### AIM

The aim of this study was to assess the efficacy of rehabilitation after hip arthroplasty and compare the quality of life in patients before and after surgery.

#### RESEARCH PROBLEMS

Was the level of pain in patients after hip arthroplasty and rehabilitation lower than that before the procedure?

Did the quality of life improve after hip surgery and rehabilitation as compared to the quality of life before the procedure?

Is the painless walking distance after arthroplasty longer than before the procedure?

Looking back, are study patients satisfied with the procedure?

#### MATERIALS AND METHODS

The study was conducted at the ConcordiaSalus Inpatient Rehabilitation Centre in Osieczek over a period of 3 months. The study group consisted of men and women aged 39 to 64 years who had undergone hip arthroplasty. The participation was completely voluntary and anonymous. The rehabilitation programme included kinesiotherapy (individual and group exercise) and physical therapy procedures (ultrasound therapy, cryotherapy, laser therapy).

The main research tool was a survey questionnaire consisting of 28 closed-ended questions and 4 open-ended ones. The questionnaire covered personal data, type of endoprosthesis, pre- and postoperative physical therapy and everyday functioning after the arthroplasty procedure.

The data collected in the study was statistically analysed.

The Pearson chi<sup>2</sup> test was used to statistically analyse the study hypotheses and J. Guilford's classification helped determine the strength of correlation between variables. The significance levels for the statistical analysis were set at 0.05 and 0.001.

All study data was presented using column charts and tables.

### STUDY GROUP CHARACTERISTICS

A total of 30 subjects were examined, all staying at the Inpatient Rehabilitation Centre as part of disability pension prevention activities of the Social Insurance Institution (ZUS). The group consisted of 18 women (60%) and 12 men (40%) (Table 1).

**Table 1.** Sex of study patients

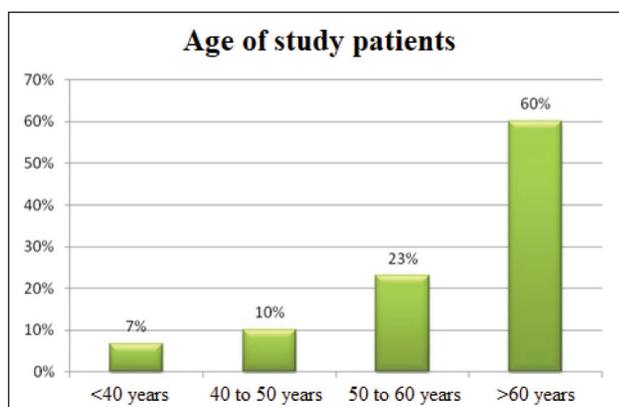
Number of patients	N	%
Women	18	60
Men	12	40
Total	30	100

The questionnaire showed that 12 study patients (40%) had a university degree and 10 study patients (33%) had vocational secondary education.

The study group included 2 patients (7%) under the age of 40 years, 3 patients (10%) aged 40 to 50 years, 7 patients (23%) aged 50 to 60 years and 18 patients (60%) over the age of 60, as shown in Figure 2.

The youngest patient was 39 years old and the oldest patient was 64 years old; the mean age in the study group was 57 years.

The study group included 5 patients (17%) weighting less than 70 kg, 6 patients (20%) weighing between 70 and



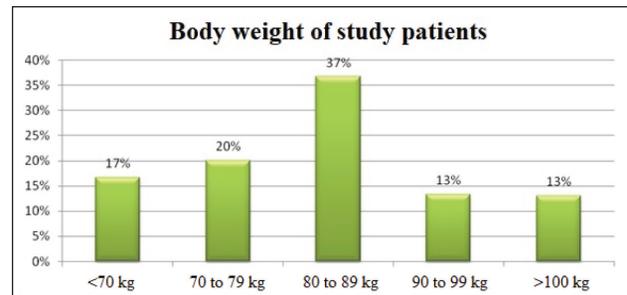
**Figure 2.** Age of study patients after hip arthroplasty

**Table 2.** Comparison of pain severity before vs. after hip arthroplasty

Pain severity	No pain		Moderate pain		Severe pain		Total
	N	%	N	%	N	%	
Before surgery	1	3	6	20	23	77	30
After surgery	13	43	15	50	2	7	30
Total	14	46	21	70	25	84	60

$$\chi^2_{calc.} = 31.78 > \chi^2_{13.815, 0.001}$$

$$r_c = 0.35$$



**Figure 3.** Body weight of study patients after hip arthroplasty (kg)

79 kg, 11 patients (37%) weighing 80 to 89 kg, 4 patients (13%) weighing between 90 and 99 kg and 4 patients (13%) weighing over 100 kg, as shown in Figure 3.

The mean body weight in the study group was 82.4 kg (range: 60 kg, 110 kg).

According to the questionnaire, 13 patients (43%) lived in rural areas and the other 17 patients lived in urban areas.

With respect to the occupation, 20 study patients (67%) answered that they did manual work and the other 10 patients (33%) were intellectual workers.

The arthroplasty procedure was performed on the right hip in 17 patients (57%) and on the left hip in 13 patients.

Out of the 30 patients participating in the study, 23 people (77%) received cementless implants and only 7 people (23%) received cemented implants.

## RESULTS

The study showed that only 1 patient (3%) did not experience hip joint pain before their arthroplasty procedure; 6 patients (20%) reported moderate pain and as many as 23 patients (77%) suffered from severe pain.

Following hip arthroplasty and rehabilitation, 13 patients (43%) said they did not experience any pain, 15 (50%) reported moderate pain and only 2 (7%) suffered from severe pain (Table 2) (Figure 4).

After hip arthroplasty and rehabilitation, the pain was eliminated or reduced as compared to its preoperative severity. A chi<sup>2</sup> test showed that the result was statistically significant and the strength of relationship with respect to the difference in pain severity after surgery vs. before surgery according to Guilford was average.

The study also showed that out of 30 study patients, 19 (63%) described their preoperative quality of life as poor, 8 (27%) described it as average and 3 (10%) as good (Figure 5).

The mean quality of life considerably improved after hip arthroplasty. After the procedure and rehabilitation, poor

quality of life was reported in 1 patient (3%), average in 5 patients (17%), good in 17 patients (57%) and excellent in 7 patients (23%) (Table 3) (Figure 6).

Data from Table 3 shows that the mean quality of life improved after the procedure and rehabilitation. Before surgery,

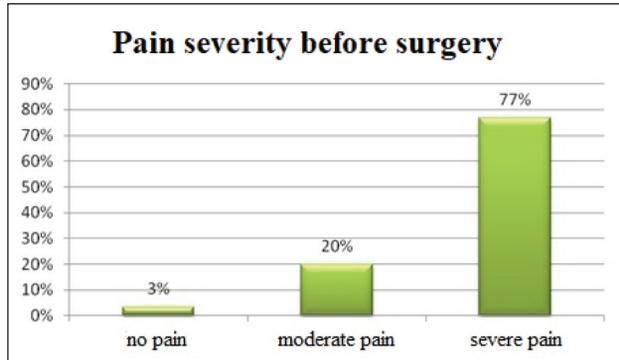


Figure 4. Pain severity before surgery

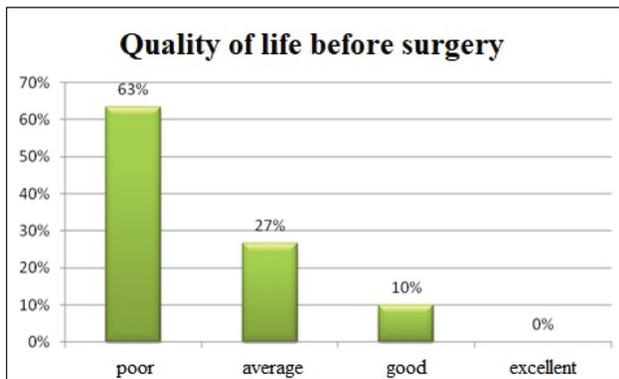


Figure 5. Quality of life before hip arthroplasty

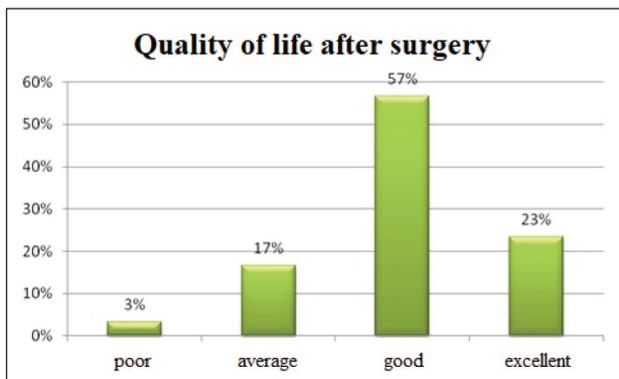


Figure 6. Quality of life after hip arthroplasty

Table 3. Quality of life before and after hip arthroplasty

Quality of life	Poor		Average		Good		Excellent		Total
	N	%	N	%	N	%	N	%	
Before surgery	19	63	8	27	3	10	0	0	30
After surgery	1	3	5	17	17	57	7	23	30
Total	20	66	13	44	20	67	7	23	60

$\chi^2 \text{ calc} = 33.69 > \chi^2 = 16.263_{3,0.001}$   
 $r_c = 0.35$

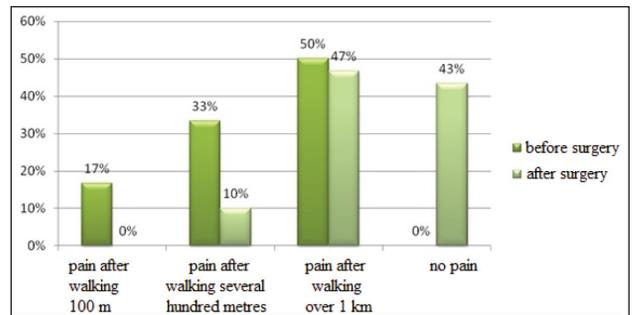


Figure 7. Walking limitations before and after hip arthroplasty

19 study patients described their quality of life as poor; this result decreased after surgery by 60 percentage points. A chi<sup>2</sup> test showed that this difference was statistically significant and the strength of correlation with respect to the difference in quality of life after surgery vs. before surgery according to Guilford was average.

Before surgery, 5 patients (17%) had difficulty walking 100 metres and 10 patients (33%) experienced pain after walking several hundred metres; for half the study group (15 patients), walking became painful after 1 kilometre. After surgery, all patients were able to walk 100 metres without pain and 14 patients (47%) experienced pain after walking several hundred metres. The number of patients without pain limitations during walks increased after surgery by 43 percentage points (13 patients) (Figure 7).

Table 4 shows that limitations due to discomfort in the hip joint were reduced after surgery and study patients were able to walk a longer distance without pain. A chi<sup>2</sup> test showed a statistically significant relationship with respect to the difference in walking limitations after vs. before surgery. The strength of this relationship was high at 0.52.

Before hip arthroplasty and rehabilitation, study patients described their physical fitness as poor (21 patients, 70%) and average (9 patients, 30%). This changed after the procedure: only 1 patient (3%) described their physical fitness as poor while 10 patients (34%) described it as average and 19 patients (63%) as good (Figure 8).

An analysis of physical fitness before and after the procedure revealed a considerable improvement. No patients described their physical fitness as good before surgery whereas after surgery and rehabilitation good physical fitness was reported by 63% of study patients.

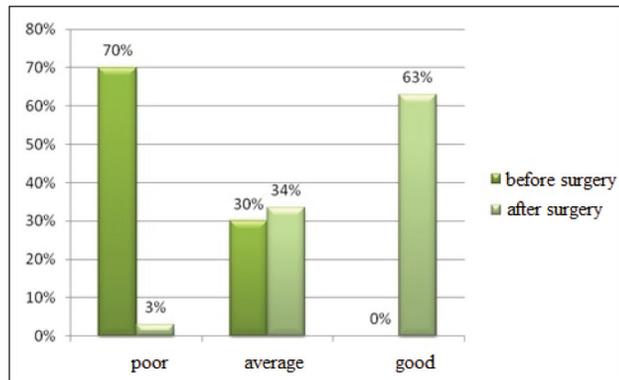
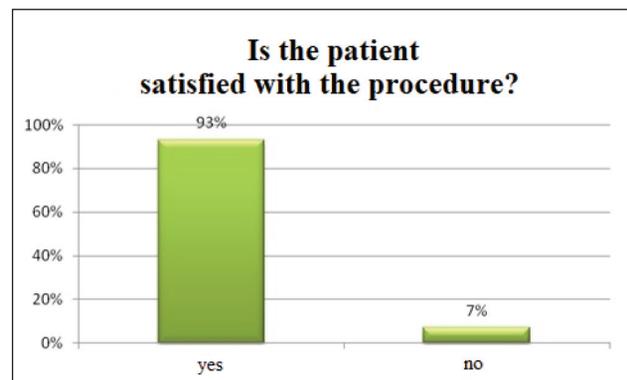
An analysis of the survey question concerning the satisfaction of study patients with their hip arthroplasty procedure showed

**Table 4.** Walking limitations before and after hip arthroplasty

Walking limitation	Pain after walking 100 m		Pain after walking several hundred metres		Pain after walking 1 km		No pain		Total
	N	%	N	%	N	%	N	%	N
Before surgery	5	17	10	33	15	50	0	0	30
After surgery	0	0	3	10	14	47	13	43	30
Total	5	17	13	43	29	97	13	43	60

$$\chi^2_{calc} = 21.79 > \chi^2_{3,0.001} = 16.263$$

$$r_c = 0.52$$

**Figure 8.** Physical fitness before and after hip arthroplasty**Figure 9.** Satisfaction with hip arthroplasty in study patients**Table 5.** Satisfaction with hip arthroplasty in men and women

Satisfaction with the procedure	Satisfied with the procedure		Not satisfied with the procedure		Total
	N	%	N	%	N
Women	16	53	2	7	18
Men	12	40	0	0	12
Total	28	93	2	7	30

$$\chi^2_{calc} = 1.43 < \chi^2_{1,0.05} = 3.84$$

$$r_c = 0.21$$

that 28 patients (93%) were satisfied with the procedure and rehabilitation and would decide to undergo this treatment again. Only 2 patients (7%) would not agree to undergo the procedure again and were not satisfied with its effects (Table 5) (Figure 9).

A  $\chi^2$  test did not show a statistically significant relationship between sex and satisfaction with the hip arthroplasty procedure. The strength of correlation between the variables according to Guilford was low.

## DISCUSSION

Osteoarthritis is a serious health issue in the society. Its main symptoms include severe pain and limited mobility in the affected joints.

Every day, patients with coxarthrosis experience severe pain around the joint and have difficulty performing activities of daily living. Conservative treatment of this disorder consists in physical therapy and rehabilitation using low-frequency currents, ultrasound therapy, laser therapy, cryotherapy, shockwave therapy and magnetic field therapy.

If the conservative management is not in any way helpful and the degenerative changes are advanced, total joint replacement may be performed.

The present research conducted in a group of 30 individuals after hip arthroplasty and rehabilitation showed that study patients were very satisfied with their quality of life and their overall physical fitness radically improved. They did not experience joint pain and reported a considerable improvement in gait quality. The painless walking distance was markedly increased. Those patients who were not able to work before surgery resumed their occupational activity after the procedure and rehabilitation.

The study showed that hip arthroplasty improved the health and quality of life in the vast majority of cases. There was a significant improvement in the mental and physical condition of the patients, stemming from the fact that the chronic severe pain they had experienced before the procedure was no longer affecting their everyday life.

Similar conclusions were reported by Anna Majda et al., who examined 70 patients before and after hip arthroplasty.

Using the Nottingham Health Profile, they assessed the effects of surgery on the quality of life. The study showed an improved quality of life with respect to socialising, social life and physical functioning following hip arthroplasty [23].

Jadwiga Stanek et al. also confirmed the efficacy of hip replacement in combatting pain. Their study conducted in a group of 120 patients after hip replacement revealed a significant improvement in everyday functioning and a pain reduction [24].

Rocławski et al. also reported similar results in their study. Using SF-36 in patients after arthroplasty, they found improvements with respect to pain, physical fitness and overall vitality as compared to the preoperative results [25].

In their study, Jachimowicz-Wołoszynek et al. analysed the effect of hip endoprosthesis implantation on the quality of life. After analysing their data, they found that the pain experienced by patients before surgery was much more severe than after the procedure. This change directly improved the quality of life after joint replacement [25].

In turn, Wilk et al. focused on the importance of physical therapy. Their study shows that rehabilitation after arthroplasty speeds up the regeneration process, reduces pain, increases muscle strength and improves the range of motion in the operated joint [25].

The present study showed that hip osteoarthritis affects functioning in all aspects of everyday life. It has a negative effect on socialising, physical activity and social identity of the patients. Patients who decide to undergo an arthroplasty procedure are tired of everyday pain and limitations in their private and professional lives.

The results of the study allow for concluding that hip replacement improves the quality of life, partly due to the fact that it leads to a pain reduction and improves the range of motion in the joint as well as the overall physical fitness. Study patients were satisfied with the surgery and became more independent after the procedure. Patients who do not require the help of other people or orthopaedic aids have a higher level of satisfaction and quality of life.

## CONCLUSIONS

Pain severity in patients after hip arthroplasty and rehabilitation was lower than that experienced before surgery.

Hip arthroplasty visibly improved the quality of life.

The postoperative level of physical fitness was considerably higher than the preoperative level of fitness.

Patients are happy and satisfied with the effects of hip arthroplasty.

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**Conflict of interest:**

The Authors declare no conflict of interest

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A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical review of the article, F – Final approval of article



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Info

## IV EDYCJA OGÓLNOPOLSKIEJ KONFERENCJI NAUKOWO-EDUKACYJNEJ SENIOR CARE 2022

**8 PAŹDZIERNIKA 2022 R., WROCŁAW**

Konferencja jest dedykowana kadrze zarządzającej oraz pracownikom placówek świadczących całodobową opiekę długoterminową/domom seniora. Ta kolejna już edycja, cieszącego się bardzo dużą frekwencją wydarzenia, odbędzie się w tym roku 8 października 2022 roku we Wrocławiu (Congress Center Haston City Hotel\*\*\*\*) i zgromadzi przedstawicieli prawie 200 placówek senioralnych z całej Polski, reprezentowanych przez ponad 450-osobową kadrę zarządzającą i opiekuńczą. Do udziału w konferencji zaproszeni zostali przedstawiciele instytucji oraz firm których działalność, usługi oraz produkty dedykowane są szeroko rozumianej branży opieki senioralnej.

Wydarzenie to będzie miało szczególny wymiar, bowiem poprzedzone zostanie w dniu 7 października 2022 r. spotkaniem organizacyjnym Krajowej Izby Domów Opieki KIDO, zrzeszającej wiodące placówki opiekuńcze z obszaru całego kraju. Izba pełni rolę rzecznika oraz reprezentanta placówek opieki długoterminowej wobec urzędów i organów administracji państwowej a także opiniuje i przeprowadza audyty produktów oraz usług kierowanych do tej grupy odbiorców. Idea utworzenia Izby spotkała się z bardzo pozytywnymi reakcjami środowiska holistycznie pojętej opieki senioralnej a jej dotychczasowe dokonania potwierdzają słuszność podjęcia tej inicjatywy.

Współorganizująca konferencję Fundacja Senior-Care jest organizacją non-profit wspierającą swoją działalnością osoby starsze i z niepełnosprawnościami, w tym w szczególności Podopiecznych placówek opiekuńczych, wymagających szczególnej pomocy i troski. Poprzednio zorganizowane przez fundację oraz Krajową Izbę Domów Opieki KIDO konferencje potwierdziły potrzebę regularnej organizacji spotkań przedstawicieli i reprezentantów środowiska świadczącego usługi opieki długoterminowej w Polsce. W Komitecie Naukowym konferencji zasiądą reprezentanci środowisk naukowych ściśle związanych z medycyną, rehabilitacją oraz szeroko pojmowaną gerontologią i geriatrią. Szczegóły dotyczące poprzednich i obecnego wydarzenia oraz pakiety sponsorskie dostępne są w poniższym linku:

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# Features of the Rehabilitation of Patients with Fractures of the Humeral Diaphysis after Osteosynthesis

## Cechy rehabilitacji pacjentów ze złamaniami trzonu kości ramiennej po osteosyntezie

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### SUMMARY

**Aim:** Determination of the target criteria of physical rehabilitation and the optimal time of their implementation depending on the methods of fixation of fractures of the humeral diaphysis.

**Materials and methods:** The results of treatment of 59 patients with diaphyseal humeral fractures have been studied. All patients underwent extra- or intramedullary osteosynthesis.

**Results:** In the absence of satisfactory stability of fracture fixation (Group A), passive movements and no active movements are recommended, especially in the presence of free bone fragments that serve as a site for muscle insertion (Group A1). The presence of free fragments with stable fixation (Groups B1 and B2) determined the possibility of active adduction and abduction movements of the shoulder. Complexes of physical rehabilitation exercises with the exclusion or prohibition of active rotational movements have been chosen for patients of Groups C1 and C2.

**Conclusions:** The proposed system of distribution of physical load during the rehabilitation period according to the "ABC" type provides a biomechanically based approach to the rehabilitation process.

**Key words:** rehabilitation, humeral fracture, diaphysis, shoulder muscles

**Słowa kluczowe:** rehabilitacja, złamanie kości ramiennej, trzon, mięśnie barku

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### INTRODUCTION

Scientific publications report that diaphyseal humeral fractures account for 3.0% of all skeletal bone fractures in the adult population [1, 2].

The largest number of high-energy injuries of the humerus is observed in young people with high occupational and social activity [3].

It is known that the consolidation of a diaphyseal humeral fracture can be achieved by the conservative treatment, though surgical intervention can accelerate this process, as well as rehabilitation [4, 5].

It has been reported that the percentage of complications in the treatment of fractures of the distal segment of the humeral diaphysis reaches 8.3-67% and subsequently can lead to a loss of work capacity, the ability to self-care and disability [6].

Shoulder and elbow joints are the areas formed with the participation of the humerus, which, due to anatomical and biomechanical features, are most prone to the development of a chain of complications, among which the contractures are rating first that require an individual rehabilitation protocol [7, 8].

There are various methods of contracture treatment: therapeutic exercises, stretching, strengthening exercises, continuous passive movements, use of electrotherapeutic methods, static progressive splinting. Recently, clinical studies have proved the effectiveness of the muscle energy technique and its therapeutic mechanisms. Muscle energy techniques are the group of relatively painless mobilization techniques used to restore mobility, reduce tissue swelling, reduce muscle spasm, stretch fibrous tissue, and restore stabilizing function of intersegmental muscles [9, 10].

Notably, in the contemporary scientific literature, attention is not sufficiently focused on measures to prevent contractures of the shoulder and elbow joints in case of damage to the humeral diaphysis at various stages of medical care, and the use of well-known postoperative rehabilitation schemes does not always solve the issue of achieving the recovery of function in certain cases [11, 12].

Since no generally accepted treatment algorithm exists to date, it must be individualized and agreed upon in the process of joint decision-making with each patient [13].

## AIM

Determination of the target criteria of physical rehabilitation and the optimal time of their implementation depending on the methods of fixation of fractures of the humeral diaphysis.

## MATERIALS AND METHODS

59 patients with fractures of the humeral diaphysis aged 16 to 85 years have been involved into the study. Among them, according to the gender distribution, women prevailed (69.5% (41)). The average age among female and male patients was 60.4 and 46.3 years, respectively.

The period of hospitalization ranged from 2 hours to 25 days from the moment of injury. In the period from 2 to 6 hours, 5% (3) of patients were hospitalized. During the first day after exposure to the traumatic factor 17% (10) of patients were hospitalized. 78% (46) of patients were hospitalized more than one day since the injury.

In 52.5% (31) of patients, the reason for fracture of the humeral diaphysis was a low-energy injury occurred as a result of a fall from own height. In 47.5% (28) of patients the injury was a high-energy and resulted from a traffic accident, an occupational injury, a fall from a height, and random violence.

Closed fractures of the humeral diaphysis were diagnosed in 100% of patients. According to the AO Classification, fractures were distributed as follows:

- 12A – 28,8%
- 12B – 44,1%
- 13C – 27,1%

The detailed description of the nature of fractures according to the AO Classification is presented in Table 1.

Surgical treatment methods were used in 100% of patients. Traditional locking-plate osteosynthesis using the LCP was performed in 57.6% (34) of patients. Antegrade blocking intramedullary osteosynthesis with a pin was used in 35.6% (21) of patients, retrograde blocking intramedullary osteosynthesis with a pin was performed in 6.8% (4) of patients.

At the preoperative and postoperative stages of treatment, in order to choose the optimal tactics and scheme of the follow-up physical rehabilitation, all patients underwent radiography of the damaged segment in two projections. Of these, 28.8%

(17) patients underwent computed tomography of the injured segment of the humeral diaphysis using anatomical 3D modeling at the stage of preoperative planning.

A comparative analysis of the position of bone fragments, the degree of their displacement relative to the normal axis of the humerus, and the anatomical fixation before and after the use of the surgical treatment methods was performed.

The nature of displacement and possible postoperative complications at the stage of medical rehabilitation were evaluated based on the scheme of typical contact relationships between the bone and muscle tissues of the studied area of the humerus.

The nature of the fracture, the presence of bone fragments and their relationship with the sites of insertion of the deltoid, pectoralis major, teres major, humerus muscles and the latissimus dorsi muscle, the degree and stability of their fixation with internal metal fixators had a key influence on the choice of tactics for the follow-up physical rehabilitation and patients' assignment to the groups.

According to the conclusions of the Ethics Commission of the PSMU, the paper meets the requirements of the Helsinki Commission. Patients, assigned in the clinical groups, participated with informed consent.

## RESULTS

After detailed processing and analysis of the data, preoperative and postoperative radiographs, anatomical 3D models, 6 clinical groups of physical rehabilitation of patients have been formed depending on the existing bone fragments, the degree of their displacement and the method of fixation, the relationship with the sites of insertion of the muscle component of the humeral diaphysis and motor activity of the damaged limb segment and adjacent joints.

The distribution of clinical groups of physical rehabilitation depending on the method of fracture fixation, fixation stability, the presence of bone fragments and their relationship with the sites of muscle insertion is shown in Table 2.

Group A1 involved 7 patients (11.9%) with high- and low-energy injuries with the presence of bone fragments. Fractures of 12B1 type were detected in 1 (1.7%) patient, 12B3 type – in 3 (5.1%) patients, 12C3 type – in 3 (5.1%) patients. Blocking intramedullary osteosynthesis with a pin was performed in 1 (1.7%) patient, locking-plate osteosynthesis with LCP – in 6

**Table 1.** The description of fractures of the humeral diaphysis in the subjects according to the AO Classification

No.	The type of AO Fracture Classification	Number of patients, persons (%)
1.	12 A1	6 (10,2)
2.	12 A2	6 (10,2)
3.	12 A3	5 (8,5)
4.	12 B1	7 (11,8)
5.	12 B2	14 (23,7)
6.	12 B3	5 (8,5)
7.	12 C1	5 (8,5)
8.	12 C2	1 (1,7)
9.	12 C3	10 (16,9)

**Table 2.** Distribution of clinical groups of physical rehabilitation of patients with fractures of the humeral diaphysis after osteosynthesis depending on the target criteria for selecting physical rehabilitation methods

Group No.	Group name	Fracture fixation method	Fixation stability	The presence of bone fragments	Relationship of bone fragments with muscle insertion sites
1.	A1	blocking intramedullary osteosynthesis, locking-plate osteosynthesis	No	Yes	Yes
2.	A2	blocking intramedullary osteosynthesis, locking-plate osteosynthesis	No	Yes	No
3.	B1	blocking intramedullary osteosynthesis, locking-plate osteosynthesis	Yes	Yes	No
4.	B2	blocking intramedullary osteosynthesis, locking-plate osteosynthesis	Yes	Yes	No
5.	C1	locking-plate osteosynthesis	Yes	No	–
6.	C2	blocking intramedullary osteosynthesis	Yes	No	–

(10.2%) patients. Fixation stability in all patients of this group was unsatisfactory. The bone fragments served as insertion points of the humerus muscles in the proximal and distal parts of the diaphyseal segment.

In patients of Group A1, passive flexion and extension of the humerus was performed in the range of 110°-155° and 25°-45°, respectively; passive flexion and extension of the forearm was made in the range of 45°-80° and 140°-160°, respectively; combinative passive rotational movements of the forearm: pronation – 110°-150°, supination – 95°-135°.

Group A2 involved 8 (13.6%) patients with fragmentary fractures. Among them, type 12B1 fractures were diagnosed in 2 (3.4%) patients, 12B2 – in 2 patients (3.4%), 12B3 – in 1 (1.7%) patient, 12C1 – in 1 patient (1.7%), 12C3 – in 2 (3.4%) patients. Blocking intramedullary osteosynthesis with a pin was performed in 2 (3.4%) patients, locking-plate osteosynthesis with LCP was performed in 6 (10.2%) patients. The stability of fixation of bone fragments was unsatisfactory. The bone fragments did not serve as a point of muscle insertion and were located in the middle third of the humeral diaphysis.

Patients of group A2 performed passive adduction and abduction movements of the humerus 110°-140° in combination with a set of exercises of Group A1.

Group B1 involved 14 (23.7%) patients with fragmentary fractures. 12B1 fractures were detected in 3 (5.1%) patients, 12B2 type – in 4 (6.75%) patients, 12C1 – in 4 (6.75%) patients, 12C3 – in 3 (5.1%) patients. Locking-plate osteosynthesis with LCP was performed in 9 (15.3%) cases, blocking intramedullary osteosynthesis with a pin – in 5 (8.4%) cases. The stability of fixation of bone fragments in patients of this group was satisfactory. Bone fragments served as insertion points of the muscular component of the humerus and were localized in the proximal and distal diaphyseal segments.

Patients of Group B1 performed active forearm flexion and extension within 30°-79° and 149°-180°, respectively; active rotational movements of the forearm: pronation - 136°-180°, supination - 136°-180° in combination with a set of Group A exercises.

Group B2 involved 13 (22%) patients with fragmentary fractures of the diaphyseal segment of the humerus. Fracture

type 12B2 according to the AO Classification was diagnosed in 9 (15.2%) patients, type 12B3 – in 1 (1.7%) patient, 12C2 – in 1 (1.7%) patient, 12C3 – in 2 (3.4%) of patients. Blocking intramedullary osteosynthesis with a pin was performed in 7 (11.7%) patients, traditional locking-plate osteosynthesis with LCP – in 6 (10.1%) patients. The stability of fixation of bone fragments was satisfactory. The bone fragments were located in the middle third of the diaphyseal segment of the humerus and did not serve as a site of muscle attachment.

In Group B2 patients, active flexion and extension movements of the shoulder in the range of 110°-155° and 25°-45°, respectively, as well as passive rotational movements of the shoulder were added to the previous set of exercises.

Group C1 involved 7 (11.9%) patients with bifragmentary fractures of the humeral diaphysis, the method of choice for treatment of which was locking-plate osteosynthesis with LCP. According to the AO Classification, type 12A1 fractures were diagnosed in 6 (10.2%) patients, 12A2 – in 1 (1.7%) patient. Fixation of the fracture in patients of group C1 was stable.

In patients of Group C1, active adduction and abduction movements of the shoulder 115°-175° were added to the complex of active and passive exercises.

Group C2 involved 10 (16.9%) patients with simple bifragmentary fractures. Patients of this group were operated using the method of blocking intramedullary osteosynthesis with pins. Fractures of type 12A2 and 12A3 were equally distributed. Fixation of the fracture of the diaphyseal segment of the humerus with an intramedullary pin was stable.

Patients of group C2 were engaged in a complex of active exercises of the previous groups with addition of active shoulder rotational movements.

The distribution of physical rehabilitation groups depending on passive and active motor activity of the damaged segment and adjacent joints is shown in Table 3.

## DISCUSSION

Among the patients of all clinical groups, medical rehabilitation was started immediately after the surgical intervention and at the end of the anesthetic methods application. The complex of exercises was performed with

**Table 3.** Description of clinical groups of physical rehabilitation depending on the type of active or passive physical activity

Group name Physical activity	A1	A2	B1	B2	C1	C2
Passive flexion and extension movements of the forearm	+	+	+	+	+	+
Passive rotational movements of the forearm	+	+	+	+	+	+
Passive flexion and extension movements of the shoulder	+	+	+	+	+	+
Passive adduction and abduction movements of the shoulder	–	+	+	+	+	+
Active flexion and extension movements of the forearm	–	–	+	+	+	+
Active rotational movements of the forearm	–	–	+	+	+	+
Active flexion and extension movements of the shoulder	–	–	–	+	+	+
Passive rotational movements of the shoulder	–	–	–	+	+	+
Active adduction and abduction movements of the shoulder	–	–	–	–	+	+
Active rotational movements of the shoulder	–	–	–	–	–	+

the help and under the supervision of medical personnel, as well as independently by the patient after his/her training and continued until the onset of consolidation of the fracture.

Passive movements and no active movements during physical rehabilitation of patients from Groups A1 and A2 are advocated due to the lack of satisfactory stability of fracture fixation. The presence of free bone fragments serving as the site of insertion of muscles (group A1) makes it impossible to perform active movements of the limb without their secondary displacement and traumatization of paraosseous soft tissue structures, such as the nerves, vessels and muscles, and provokes the formation of a secondary intermuscular hematoma.

In patients of Groups B1 and B2, fixation of fractures was satisfactory, which enabled the diverse active movements during physical rehabilitation. Active adduction and abduction movements of the shoulder are excluded in patients of group B1 due to the presence of bone fragments that serve as the site of insertion of the muscles of the proximal segment of the humeral diaphysis. Activation of these movements increases the risk of secondary displacement of bone fragments and compromising the stability of osteosynthesis.

The complex of physical rehabilitation exercises in patients of Groups C1 and C2 began with active movements, which was determined by the absence of bone fragments and the stability of the performed osteosynthesis. Exclusion of active rotational movements in patients of Group C1 was associated with the prevention of the development of foci of local osteoporosis and migration/damage of metal fixators.

The assessment of the functional activity of the elbow and shoulder joints was carried out within 8-10 weeks after the surgical intervention and after the onset of consolidation of the fracture of the diaphyseal segment of the humerus using the MEPI and CMS scales, respectively.

According to the MEPI scale, the functional activity of the elbow joint in patients of Group A1 and A2 ranged from 82 to 89 points and was rated as good. Functional activity of the elbow joint according to the above scale in patients of Group B1, B2, C1, C2 ranged from 90 to 99 points and was assessed as excellent.

According to the CMS scale, the difference in the functional activity of the shoulder joint on the injured and healthy side in patients of Group A1 and A2 ranged from 12 to 18 points and indicated a good result. The functional activity of the shoulder joint of the injured limb in patients of Group B1, B2, C1, C2 had a score of 17 to 8 points compared to the healthy one, which indicated a good and excellent result.

## CONCLUSIONS

The proposed system of distribution of physical load during the rehabilitation period according to the “ABC” type provides a biomechanically grounded approach to the rehabilitation process and allows to prevent the occurrence of iatrogenic complications in the early and remote postoperative periods, prevents disfunction of the shoulder and elbow joints.

The concern in the target criteria for choosing physical rehabilitation tactics for patients with humeral diaphysis fractures after osteosynthesis, as well as the concern in the biomechanical features of bone fragments, which are caused by the contact relationship between bone and muscle tissues, enables choosing the optimal physical exercises for each patient. This determines the early start of physical rehabilitation in patients with fractures of the humeral diaphysis to increase the functional activity of adjacent joints, reduce the risk of contractures, improve the patient's quality of life and reduce the period of incapacity.

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Info

**POLISH ASSOCIATION OF HEALTH RESORT PATIENTS**

On the initiative of Professor Irena Ponikowska, the Polish Association of Health Resort Patients was established in 2019. The Association aims to integrate patients using health resort treatment, increase the availability of health resort treatment for subjects in need, improve the quality of services provided in the health resort treatment sector, cooperate with doctors and health resort treatment facilities, and involve in patient education.

Each member of the Association will be able to benefit from discounts in fees for stay and treatment, during commercial stays in selected health resort treatment facilities, and take part in conferences, workshops, and consultations organized by the Association.

Natural and legal persons may be members of the Association. Membership in the Association for natural persons is free, whereas legal persons may become supporting members.

We invite both patients and companies operating in the field of health resort medicine to work together.

Please visit the website of the Association [udrowiskowi.eu](http://udrowiskowi.eu) where you will find more information as well as a declaration of joining the Association.

*The Board of the Polish Association of Health Resort Patients*

# Comprehensive Rehabilitation of Cardiac Surgery Patients with Acute Left Ventricular Failure who Underwent Coronary Artery Bypass Grafting with Cardiopulmonary Bypass

## Kompleksowa rehabilitacja u pacjentów z ostrą lewokomorową niewydolnością serca poddawanych pomostowaniu aortalno-wieńcowemu z zastosowaniem krążenia pozaustrojowego

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### SUMMARY

**Aim:** To develop and implement a comprehensive rehabilitation of cardiosurgical patients with acute left ventricular failure who underwent on-pump coronary artery bypass grafting.

**Materials and Methods:** 500 patients underwent on-pump coronary artery bypass grafting. Sixty patients who required inotropic support in the postoperative period were selected. The patients were divided into two groups of 30 people each. In both groups, psychological and physical rehabilitation was carried out in accordance with the algorithm developed by us. The protocol EACTS, 2017 for the main group was supplemented with a metabolic support component, the introduction of a combination of levocarnitine and arginine.

**Results:** Psychological and physical algorithm was developed and implemented. In the basic group, the recovery time of hemodynamics and the total dose of the inotropic drug were shorter/lower than in the control one.

**Conclusions:** Stressful moments informing the patient in the perioperative period is a powerful tool for psychological rehabilitation. Aerobic training and respiratory physiotherapy are mandatory elements of physical rehabilitation. The introduction of a combination of levocarnitine and arginine has a positive effect on the terms of activation of patients, and reduces the stay in the intensive care unit.

**Key words:** CABG, rehabilitation, levocarnitine, arginine

**Słowa kluczowe:** CABG, rehabilitacja, lewokarnityna, arginina

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### INTRODUCTION

Cardiovascular disease accounts for one third of deaths worldwide [1]. Mortality from coronary heart disease (CHD) in Western countries has declined sharply in recent decades. This is due to the colossal efforts in the field of primary prevention, improving the diagnosis and treatment of CHD. However, developing countries are making great strides and setting new challenges for their health systems. While globalization often improves healthcare systems, adopting a Western lifestyle can lead to a higher prevalence of cardiovascular disease risk factors [2].

CHD is based on dysfunction of both vascular and myocardial processes, which are induced and exacerbated by ischemia, hypoxia, oxidative stress, inflammation, and apoptosis. Recently, studies on the importance of autophagy

in the pathogenesis of CHD have been accumulating that report, with more and more researchers paying attention to the interaction between autophagy and apoptosis [3]. The most common cardiovascular diseases such as CHD, atrial fibrillation, heart failure, hypertension and stroke are complex processes reflecting the interaction of genetic and environmental factors. Unlike monogenic cardiovascular diseases such as hereditary cardiomyopathies, arrhythmias and vascular disorders, which are responsible for rare DNA variants with large effects, complex diseases are affected by common and rare DNA variants at multiple loci distributed throughout the genome. Since these variants usually have small effects and do not lead to classical Mendelian patterns of inheritance in families, large-scale population-based association studies are required to detect them [4].

Despite advances in the pharmacological treatment of CHD, coronary artery bypass grafting (CABG) remains the most effective treatment for coronary disease. The results of the 10-year follow-up STICHES study demonstrated that CABG is associated with a significant reduction in all-cause mortality, cardiovascular mortality, and readmissions for heart failure compared with medical therapy in patients with ischemic left ventricular dysfunction [5]. Over the past few decades, there has been an improvement in the technique of performing the operation and a decrease in the number of complications. However, the patient after such an operation still requires rehabilitation [6]. Cardiorehabilitation is a set of interventions that may include a variety of treatments, including exercise, risk factor education, behaviour modification, psychological support, and strategies to address traditional risk factors for cardiovascular disease. Cardiorehabilitation is an important part of modern cardiac care and is considered a priority activity in countries with a high prevalence of CHD [7]. Cardiorehabilitation is usually understood as the following concept, “A coordinated sum of actions necessary to beneficially influence the underlying cause of cardiovascular diseases, as well as to provide the best possible physical, mental and social conditions, so that patients can, through their own efforts, maintain or resume optimal functioning in their community and by improving health behaviours to slow or reverse disease progression” (BACPR 2014)” [8]. In more detail, three main components can be distinguished in rehabilitation: psychological, physical and medical.

The psychological component of rehabilitation includes a complex of non-drug interventions aimed at combating such conditions as pain perception, fear, anxiety, depression, anger, low self-esteem and lack of social support [9].

The physical component of rehabilitation is aimed at restoring the patient's ability to endure the load, increasing muscle tone, and preventing broncho-pulmonary complications. This component is usually divided into aerobic training and respiratory physiotherapy [10].

Drug rehabilitation is no less significant. It includes a complex of pharmacological effects that helps to reduce the time of postoperative hemodynamic disorders. Which, in turn, contributes to early activation and speedy transfer of the patient from the intensive care unit [11-13].

### AIM

The objective of the present research is to develop and implement a comprehensive rehabilitation of cardiosurgical patients with acute left ventricular failure who underwent coronary artery bypass grafting with cardiopulmonary bypass.

### MATERIALS AND METHODS

From 2016 to 2021, in the State Institution of Science “Research and Practical Center of Preventive and Clinical Medicine” State Administrative Department, Kyiv, 500 patients were operated on. All of them underwent coronary artery bypass grafting with cardiopulmonary bypass (CPB). 60 patients were selected, those who required inotropic support in the postoperative period.

The patients were divided into two groups, each of 30 people. In both groups, the methods of psychological and physical rehabilitation were identical.

Psychological rehabilitation of 60 patients with coronary artery disease was carried out by an anesthesiologist. During the preoperative examination, the anesthesiologist informed the patient about the most stressful periods of time for the patient in the perioperative period according to the algorithm developed by us on the basis of literature data [9], which includes detailed and complete information about stressor moments for the patient in the perioperative period.

Physical rehabilitation of all patients is also presented in the form of an algorithm of actions (a combination of respiratory physiotherapy and dosed physical activity) in the postoperative period and was carried out according to the method of Højskov I. E. *et al.* (2019), which includes early physical and psychological and pedagogical rehabilitation [10].

Methods of drug rehabilitation in the groups differed. The existing protocol – “Recommendations on perioperative drug therapy in adult cardiac surgery, EACTS, 2017” [14] – was supplemented for the main group with a metabolic support component – the introduction of a combination of levocarnitine and arginine.

The main group included 22 men and 8 women aged 37 to 78 years, the average number of bypasses was  $3.17 \pm 0.65$ . To stabilize hemodynamics, inotropic support with dobutamine and metabolic support with a combination of levocarnitine and arginine were used.

The control group also included 22 men and 8 women aged 37 to 81 years, the average number of bypasses was  $3.3 \pm 0.54$ . Stabilization was carried out only with dobutamine.

There were no statistically significant differences in the groups (gender, age, number of bypasses applied),  $p > 0.05$ .

A study was made of the terms of hemodynamic stabilization (in hours) and the dose of inotropic drugs used (dobutamine, in  $\mu\text{g}/\text{kg}$ ) in both groups of patients. The MedStat program was used to analyse the results. The analysis used comparison criteria for unrelated samples. The critical level of significance was  $p < 0.05$ .

### RESULTS

Psychological rehabilitation of 60 patients with coronary CHD began with a preoperative examination by an anesthesiologist and was carried out according to the algorithm developed by us (Table 1). After collecting an anamnesis and a physical examination, the anesthesiologist emphasized that such operations were carried out “routinely”; all techniques have been worked out and have a minimum of consequences. The anesthesiologist informed in detail what would happen to the patient from the moment of transportation from the ward till the moment the anesthetic starts acting, and also described in detail the process of awakening: where the patient would be, what would happen to the patient and what the medical staff would do. Before removing the drains, the patient received detailed information about what to expect, what the removal technique was and what type of anesthesia

**Table 1.** Algorithm for the psychological rehabilitation of patients' cardiosurgical profile in the pre- and postoperative period

Stage	
1	Psychological rehabilitation. Preoperative stage.
1.1.	Psychological contact with the patient. The phrase: "Such operations are carried out "routinely", all methods have been worked out and have a minimum of consequences" is obligatory
1.2.	Informing the patient.
1.2.1.	Description of the process of transportation to the operating room and „entry" into anesthesia.
1.2.2.	Description of the transfer process to the ICU and „waking up" after surgery.
2.	Psychological rehabilitation. Postoperative stage.
2.1.	Organization of psychological contact with the patient during the entire stay in the ICU.
2.2.	Informing the patient: his condition, treatment plan and postoperative rehabilitation.
2.2.1.	Description of the drainage removal process: surgical technique, type of anesthesia, expected sensations.
2.2.2.	Description of the transfer process from the ICU to the ward: transfer procedure, availability of staff, availability of call signaling.
2.3.	Informing the patient's relatives: the patient's condition, treatment plan and postoperative rehabilitation.
3.	Evaluation of the effectiveness of psychological rehabilitation - RASS scale (Richmond Agitation-Sedation Scale), in case of its inefficiency - medical sedation.

he/she would receive. The maximum awareness of the patient allowed the patient to be transferred from the intensive care unit (ICU) to the ward in a less stressful way. In the ICU, the patient develops a sense of security and psychological comfort which we maintained during the transfer to the ward. We also attracted and informed the patient's relatives about his/her condition, treatment plan and postoperative rehabilitation. Having received a detailed description of upcoming events, the patient, as a rule, felt a decrease in the level of emotional stress in the most stressful periods of time for the patient in the perioperative period. The effectiveness of psychological rehabilitation was assessed in the dynamics of treatment using the RASS scale (Richmond Agitation-Sedation Scale) and was considered achieved if the RASS was 0 or -1 points [15]. At that moment, when the events described by the anesthesiologist occurred, the patient experienced them less stressfully, in case of inefficiency, we performed additional medical sedation.

The physical rehabilitation of the patient consisted of respiratory physiotherapy and aerobic training (Table 2). Respiratory physiotherapy was started immediately after the end of the operation and extubation of the patient. During the first stage, the patient was prescribed CPAP therapy. It is aimed not only at resolving formed atelectasis in the perioperative period, but also at preventing further atelectasis. CPAP therapy

was carried out 3-4 times a day for 30-60 minutes during the entire period of the patient's stay in the ICU. According to indications, the procedure could be continued in the surgical hospital. The second stage included classes on a breathing simulator. The essence of the method is to create resistance to the patient's exhalation with a water column. The physiological focus is similar to CPAP therapy. Classes on the respiratory simulator began with 20-40 exhalations per day with a gradual increase to 100 exhalations per day. Physical training began the day after the operation. During this period, the loads were minimal: raising the head end of the bed to 90°, transferring the patient to the "sitting" position. The next day, when, as a rule, the drains had already been removed, the load was increased. During this period, the patient could already be transferred to the "standing" position. Next, the period of aerobic training began immediately. Aerobic and anaerobic loads differ in the way the ATP molecule, in other words, energy in the body is formed. The main difference is whether oxygen plays a key role in the formation of energy that our body needs for training, or not. Aerobic exercise began with the simplest movements, which can be performed even by asthenized patients. In the future, the amount and loading were increased. At the same time, special attention was paid to the expansion of the patient's motor regimen with the

**Table 2.** Algorithm of physical rehabilitation of patients with cardiosurgical profile in the postoperative period

Stage	
1.	Respiratory physiotherapy.
1.1.	CPAP therapy, 3-4 times a day for 30-60 minutes for the entire duration of the patient's stay in the ICU.
1.2.	Classes on the breathing simulator - 20-40 exhalations per day with a gradual increase to 100 exhalations per day.
2.	Physical training.
2.1.	The next day after the operation: raising the head end of the bed to 90°, transferring the patient to the "sitting" position.
2.2.	After removal of drains: point 4.2.1. + transfer to the standing position.
2.3.	After the transfer from the ICU: gymnastics, beginning with the simplest movements with minimal loading with a gradual expansion of range of motion and increasing the loading.
3.	Evaluation of the effectiveness of physical rehabilitation: the patient returned to the usual motor mode, fully serves themselves, tolerates aerobic loads of medium intensity. In case its inefficiency has been detected, the patient should refer to a rehabilitation center.

expectation that by the time of discharge, the patient returned to the usual regimen, fully served themselves and tolerated aerobic exercise of moderate intensity.

The protocol of medical rehabilitation was supplemented. The difference in the medical rehabilitation of the studied groups of patients was in the methods of correction of acute left ventricular failure (ALVF) after CABG with CPB. The main group received metabolic support with a combination of levocarnitine and arginine in addition to the traditional treatment of ALVF with inotropes, in particular, dobutamine.

Dosage of dobutamine was calculated (in accordance with the manufacturer's instructions) in the range from 2 µg/kg/min to 15 µg/kg/min, under the control of hemodynamics and blood gas parameters; dosage of levocarnitine and arginine – Tivorel preparation (also in accordance with the instructions) – 2000/4200 mg for 24 hours of treatment.

In the main group, the hemodynamic recovery time was 25 [17:38] hours, and in the control group – 32.5 [28:48] hours (Figure 1). An interval assessment of the indicators of the time needed for renewal of hemodynamics during the period between the completion of the operation and stabilization is shown in the figure. It represents the median (dot), the deviation of the median (rectangle) and 95% DW (distribution whisker).

A number of calculations were carried out to verify the statistical differences. Based on the calculation of the Shapiro-Wilk test, the distribution of the sample was found to be different from normal. A comparison of central trends for two independent samples was carried out; the calculation was performed using the Wilcoxon W-test;  $W = 693.5$ ; central trends differ at the  $p = 0.001$  significance level. Multiple comparisons were calculated for 2 samples *i.e.* Kruskal-Wallis rank univariate analysis; central trends differ at the  $p = 0.001$  significance level;  $H = 10.7$ , number of degrees of freedom  $k = 1$ ; a difference was found at the significance level of  $p = 0.001$ . The Dunn's criterion was calculated;  $Q = 3.28$ ; the difference was statistically significant at  $p < 0.01$ . Data processing methods confirmed a statistically significant difference in hemodynamic recovery time in the main and control groups ( $p < 0.05$ ).

In the main group, the total dose of the inotropic drug was 40 [22:65] µg/kg, and in the control group - 53 [42:72] µg/kg (Figure 2). The figure shows the interval assessment of the total dose of the inotropic drug from the end of the operation to the stabilization of hemodynamics. It represents

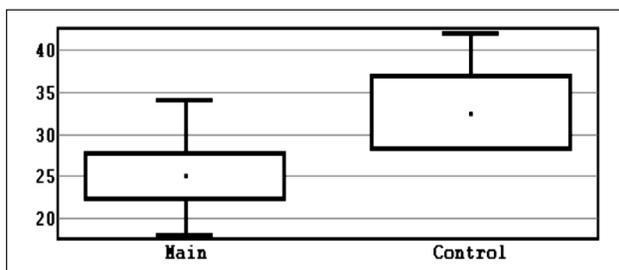


Figure 1. Recovery time, h. Confidence interval of hemodynamic recovery time

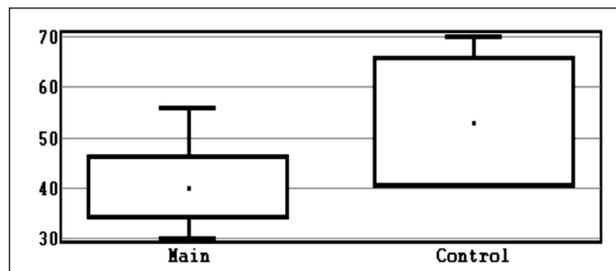


Figure 2. Total dose of inotropic drug, µg/kg. Confidence interval of the total dose of the inotropic drug

the median (dot), the deviation of the median (rectangle) and 95% DW (distribution whisker).

A number of calculations were also carried out to verify the statistical differences. The Shapiro-Wilk test also showed a non-normal distribution of the sample. Comparison of central trends for two independent samples was carried out using Wilcoxon W-test;  $W = 748.0$ ; the central trends differ at the significance level  $p = 0.013$ . Multiple comparisons for 2 samples were carried out, Kruskal-Wallis rank univariate analysis was conducted;  $H = 6.1$ , the number of degrees of freedom  $k = 1$ . A difference was found at the significance level  $p = 0.013$ . The Dunn's criterion was calculated;  $Q = 2.47$ ; the difference is statistically significant at the significance level  $p < 0.05$ . Data processing methods also confirmed a statistically significant difference in ( $p < 0.05$ ).

## DISCUSSION

As a result of the application of the algorithm and individually selected programs of physical, psychological and drug rehabilitation, a comprehensive assessment of the state of the functional capabilities of the cardiovascular system, based on modern methods of diagnosis and monitoring, the degree of coronary insufficiency and the state of myocardial propulsion, a higher degree of treatment efficiency was achieved for the patients of the main group.

It has been proved that the introduction of metabolic support with a combination of levocarnitine and arginine significantly reduces the time of hemodynamic stabilization, reduces the drug load with inotropes in patients with ALVF who underwent CABG with CPB. Which, in turn, has a positive effect on the terms of activation of patients and contributes to the speedy transfer from the intensive care unit. This is due to the fact that hemodynamic instability is the main deterrent in the issue of patient activation and the decision to transfer them from the intensive care unit.

Given that in the main and control groups, the methods of psychological and physical rehabilitation were the same, and only the methods of drug rehabilitation differed, it can be concluded that the technique presented in the work, which includes the introduction of a combination of levocarnitine and arginine into the treatment regimen for ALVF, helps to reduce the time rehabilitation of patients after CABG with CPB, compared with the use of existing traditional methods described in the available medical literature [10-14, 16].

## CONCLUSIONS

1. Comprehensive and complete informing the patient about stressful moments for the patient in the perioperative period is a powerful tool for psychological rehabilitation.
2. Aerobic training and respiratory physiotherapy are indispensable elements of physical rehabilitation, the use of which requires an individual approach and reliable performance criteria.
3. The algorithm developed by us for the psychological and physical rehabilitation of cardiac surgery patients systematizes the work of an anesthesiologist and increases its efficiency.
4. The introduction of a combination of levocarnitine and arginine into the regimen for the treatment of acute left ventricular failure after coronary artery bypass grafting with cardiopulmonary bypass, as an element of medical rehabilitation, reduces the time of hemodynamic stabilization, reduces the drug load with inotropes. This favorably affects the terms of activation of patients, reduces the stay in the intensive care unit.

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*In conducting the study, the authors adhered to the principles of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1997), the relevant provisions of the WHO, the International Council of Medical Research Societies, the International Code of Medical Ethics (1983) and the laws of Ukraine. Each patient included in the study signed an informed consent for medical intervention. The study protocol was approved by the local ethics commission.*

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A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical review of the article, F – Final approval of article

# Physical Therapy of Elderly People with Lumbosacral Steocondrosis in the Conditions of Sanatorium-resort Institution

## Fizjoterapia osób starszych z osteochondrozą lędźwiowo-krzyżową w warunkach zakładu sanatoryjno-uzdrowiskowego

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### SUMMARY

**Aim:** To improve the process of physical therapy of elderly people with lumbosacral osteochondrosis in the conditions of health complex of the sanatorium-resort establishment.

**Materials and Methods:** The study was conducted on the basis of the health complex of the sanatorium-resort institution "Hopry" in Hola Prystan, Kherson region, Ukraine. The study involved 40 patients aged from 61-74 years with lumbosacral osteochondrosis. To implement the tasks, patients were divided into two groups: core and control.

**Results:** As a result of our study, we obtained the following data: all patients in the control and main groups described the dynamics of their general condition as positive. This was manifested by the fact that after the proposed program of physical therapy in a sanatorium, patients had reduced pain, increased range of motion in the intervertebral joints, improved mobility of the patient's spine, thereby increased motor abilities of patients, which gave a significant stimulating response. improving their psycho-emotional state.

**Conclusions:** The developed set of physiotherapeutic measures in the sanatorium significantly promotes the development of motor skills and maintains the optimal level of functional capabilities of the elderly with osteochondrosis, increases their physical activity and significantly reduces pain by 80%. The efficiency of rehabilitation of elderly people with red and lumbar osteochondrosis has also increased by 30% in all indicators, under the influence of the traditional complex – by 21%. This gives grounds to recommend the proposed complex for practical use in the system of physical therapy of elderly people with lumbosacral spine in sanatoriums.

**Key words:** health complex, spine pathology, physical rehabilitation

**Słowa kluczowe:** zdrowie, schorzenia kręgosłupa, rehabilitacja ruchowa

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### INTRODUCTION

Diseases of the spine occupy the first place among the population of the globe. Among them, one of the most common pathologies is osteochondrosis of the spine [1]. The relative importance of its manifestations among all diseases of the peripheral nervous system is from 67% to 95%. Significant spread of this disease is among people of working age, high level of disability, large economic losses determine the urgency of this problem, its epidemiological and socio-economic significance [2]. Numerous data of statistics show not only a large number of osteochondrosis diseases, but also the lack of a tendency to reduce them in recent years. It is observed that patients with lumbar osteochondrosis of the II degree have a higher level of anxiety and a lower degree of life satisfaction [3]. Osteochondrosis affects people in their prime and is the cause of long-term disability in 20 – 45% of patients. Often this disease leads to disability [4, 5].

The development and experimental justification of new methods of rehabilitation are, in our opinion, necessary and justified, because the use of various means of conservative treatment of osteochondrosis of the spine does not always lead to the desired results. Significant components of rehabilitation treatment are various methods of therapeutic physical complex (TPC), massage, physiotherapy, hydrotherapy etc. It should be taken into account that physical therapy is the main method of active functional therapy, alone and in combination with other means of physical rehabilitation, has a positive effect on treatment results [6-8]. Along with traditional diagnostic methods, the energy characteristics of biologically active points (acupuncture points, or AP) are used [9].

Analysis of the thematic literature shows that the therapeutic effect achieved by manual exposure, stretching, the use of various physical methods, cannot be stable without strengthening of

the muscles that fix the spine, without further prolonged use of exercise therapy. Methods of physical rehabilitation can increase the effectiveness of basic medicinal therapy. These include: isometric exercises, post-isometric muscle relaxation, proprioceptive neuromuscular relief, postural exercises and special massage. In this case, a certain and significant interest is the development of rehabilitation programmes with the use of special exercises with low amplitude in the physical rehabilitation of patients with osteochondrosis [10-13].

In this regard, it seems relevant to develop and substantiate the method of physical rehabilitation of patients with osteochondrosis, taking into account the effect of simultaneous performance of low-amplitude exercises in combination with spinal unloading.

### AIM

The aim of the work is to improve the process of physical therapy of elderly people with lumbosacral osteochondrosis in the conditions of health complex of the sanatorium-resort establishment.

### MATERIALS AND METHODS

The following methods were used to solve the research problems:

- methods of obtaining retrospective information (study, analysis and compilation of data from special literature);
- anthropometric measurements (weight, height);
- methods of current information collecting: determination of the functional state of the respiratory (vital capacity of the lungs – VLC, vital index – VI), cardiovascular system (systolic blood pressure – SBP, diastolic blood pressure DBP, heart rate – HR);
- methods of spinal column research.

Schober's test: marks are placed on the skin at the level of the spinous L1 and 10 cm above, then the distance between the marks is measured at maximum forward bending (normally increases by 4-5 cm). The patient should not bend one's legs at the joints.

Modified Schober test (measurements of lumbar-thoracic mobility): in the standing position, mark 10 cm from the spinous S1 between the "dimples of Venus" – the upper-posterior spines of the longitudinal bone). Then the patient bends, and there are three segments of 10 cm. Then the patient bends over, and again the distance between the marks is measured: the lower segment should be reduced by 50%, the middle – by 40%, the upper – by 30%. Shortening can be greater only in tall people. An alternative is to measure the distance C7 – T12, T12 – S1; in the vertical position and the state of maximum flexion, the distance in the thoracic area should increase by 2-3 cm, in the lumbar – by 7-8 cm. Measures of the distance from the spinous process C7 to the sacrum in a standing position. At the maximum forward bending normal distance should increase by 5-7 cm.

Stibor test (extension, rotation). The patient should stretch back as much as possible. Spinous bones provide orientation when viewed from the side. Normally, a person can unbend, deviating by 30% from the vertical line. Pain when stretching indicates discogenic disorders, pathology of the articular

surfaces. Side bents are performed in the absence of bending or rotation of the torso, arm along the torso. The test is performed in both directions (mobility is compared). A slight difference indicates pathological changes (scoliosis, osteochondrosis, disc herniation). Additional measurements are performed on the back. The apparent line connecting T1 and S1 should normally deviate by 30-35°. The patient actively leans to the side, and the volume of motions is determined.

Rotation. At examination of the patient, one is asked to turn shoulders and a torso in each part as much as possible, without rotation of a pelvis. It is better to carry out test in a sitting position, or to fix a pelvis at examination. Normal rotation is 40-45°, any asymmetry is a pathology. When palpating painful points, sites of hypostasis, existence of swelling or asymmetry are defined.

Amplitude of movements of the thoracic spine: when bending – 50°, when unbending – 55°, side bents – 100°, turns – 40°. Amplitude of movements of the lumbar spine is when bending – 40°, when unbending – 30°, side bents – 35°, turns – 5°. Side movements are limited more in the opposite direction, the pain is more pronounced when leaning to the sore side. Disturbances of rotational movements are rare. The mobility of the spine through the pain is usually impaired in various planes, but more often suffers from flexion and extension.

Evaluation of the physical therapy effectiveness involves determination not only of the dynamics of morphofunctional defect (clinical syndromes), but also the functional capabilities of the patient in his daily life. An adequate task of rehabilitation, a valid and reliable tool is the Oswestry Low Back Pain Disability Questionnaire [14], which includes ten sections describing different areas of the patient's life. In each section there are six descriptions of the possible condition of the patient, of which each first is evaluated at 0 points, every sixth – at 0,5 points (the patient should not know about the evaluation system). The patient is asked to choose one description, most accurately corresponding to his condition, from each section. Total evaluation is carried out by dividing the sum of points obtained in all sections by the maximum possible sum of points (5) with the multiplication of the obtained indicator in percent; in that case, if the patient for some reason does not give an answer to one of the sections, the amount of obtained points is divided by the maximum possible number of points in those sections to which the patient answered. An integral assessment of the effectiveness of rehabilitation can be the nature of the disease course, as well as the assessment of life quality by patient.

The study was conducted on the basis of the health complex of the sanatorium-resort institution "Hopry" in Hola Prystan, Kherson region, Ukraine. The study involved 40 patients aged from 61-74 years with lumbosacral osteochondrosis. To implement the tasks, patients were divided into two groups: core and control. The core group included 20 patients with lumbar, lumbosacral osteochondrosis with whom we conducted our own special set of rehabilitation measures. The control group consisted of 20 patients with the same diagnosis, who were treated according to the standard methods of the sanatorium-resort establishment.

The experiment was conducted for three months from September to November 2021 and consisted of three course shifts of the sanatorium lasting 21 days, during each course a certain number of patients were taken for a similar study, which had three stages:

Stage 1 – the beginning of shift, included preparation for the study. The analysis of scientific and methodical literature was carried out, the plan of work was developed and specified, medical cards were analysed. Indicators characterizing the functional state of external respiration were also taken, the initial assessment of the functional capabilities of the respiratory system, musculoskeletal system was given. Therapeutic gymnastics classes according to our method were started. The length of the period was 2 days.

Stage 2 – we carried out rehabilitation activities, the main of which were therapeutic gymnastics, baths, physiotherapy and underwater stretching, massage of the elderly with osteochondrosis. Conversations about the important impact of the proposed method, which improves the general condition of patients, were conducted with the medical staff of the sanatorium and patients. The length of the period was 16-17 days.

Stage 3 – we conducted a final study and assessed the functional status of patients. The length of the period was 2 days.

To assess the effectiveness of rehabilitation measures, a survey of patients in the control and core groups was conducted at the beginning and end of the experiment. The criteria for testing the effectiveness of our programme were the assessment of the development of motor skills and functional indicators of the cardiorespiratory and muscular systems.

## RESULTS

All patients in the control and core groups described the dynamics of their general condition as positive. During the rehabilitation programme, patients felt the reduction of pain, range of motion in the intervertebral joints increased, mobility of the sore spine area improved, due to this the motor capacity of patients increased, which gave a significant stimulating response to improve their psycho-emotional state. This had a positive effect on the tone of the deep muscles of the spine, preventing its spasms, coordination skills improved, social activity increased, psychological background normalized. Positive changes were also noted in the activity of the cardiovascular system, which was expressed in the normalization of blood pressure, heart rate, physical workability increased, recovery time after exercise reduced. Patients became physically stronger, their mood and sleep improved, and they wanted to continue

attending procedures. As a result of the experimental work, we obtained the following data.

When comparing the average values of VCL and VI in patients of the core and control groups suffering from osteochondrosis, no intergroup differences were found (Table 1).

It should be noted that during the examination of patients with VI, in this category of people, the indicators were below normal by 20.5%, and VCL levels – below normal by 17, 3%.

Control changes in VCL parameters and their subsequent ratio showed that the VCL indicators of the studied core group before the experiment were  $3,87 \pm 0,15$  litres after the experiment –  $4,01 \pm 0,10$  litres. In the core group at the beginning of the experiment, these values were  $3,79 \pm 0,11$  litres; after the experiment –  $3,85 \pm 0,9$  litres. Indicators of VI before the experiment in the subjects of the core group were  $47,45 \pm 1,21$  ml/kg, after the experiment –  $48,3 \pm 1,1$  ml/kg. The VI of the control group before the experiment was  $46,9 \pm 1,44$  ml/kg, after the experiment –  $47,2 \pm 1,23$  ml/kg. At the end of the study, a positive dynamic in both groups, due to adaptation to physical activity was observed.

When analysing the indicators of the respiratory system in the elderly, the data obtained after the experiment in the core group increased more than in the control group. In our opinion, this is due to the small number of breathing exercises in the proposed complex of exercise therapy. The dynamics of the data of both groups showed that classes on the experimental and traditional set of therapeutic physical exercises enhances the activity of respiratory function of the inhalation. Thus, it is necessary to include more breathing exercises in the developed and traditional set of exercises for osteochondrosis of the spine, especially in the final part of the class.

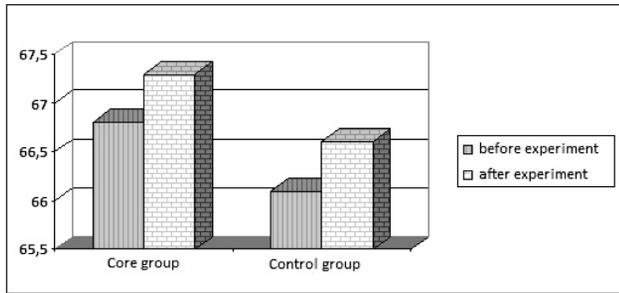
When comparing the heart rate indicators and blood pressure (BPs, BPD) in patients of the core and control groups suffering from osteochondrosis, no intergroup differences were found.

Control measurements of heart rate and blood pressure and their subsequent ratio showed (Figure 1) that the heart rate indicator before the experiment in the subjects of the core group was  $66,8 \pm 0,74$  beats/min., after the experiment –  $67,3 \pm 0,62$  beats /min. In the core group, these values before the experiment were  $66,1 \pm 0,76$  beats/min., after the experiment –  $66,6 \pm 0,65$  beats/min. It was determined (Figure 2), that the indicators of BPs in the core group before the experiment averaged  $125,25 \pm 2,07$  mm Hg., after the experiment –  $122,5 \pm 1,9$  mm Hg. In the control group at the beginning of the experiment, these values were  $125,25 \pm 2,19$  mm Hg, after the experiment –  $123,3 \pm 2,03$  mm Hg. It is

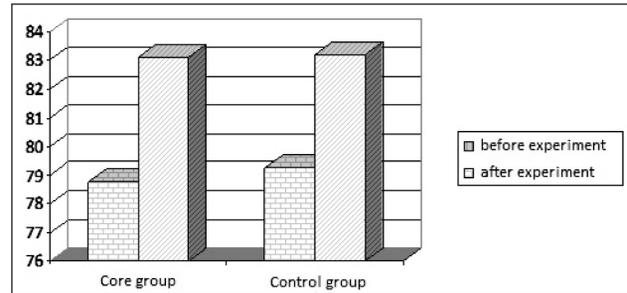
**Table 1.** The average vital capacity of the lungs and the vital index of the elderly with osteochondrosis of the core (N=20) and control (N=20) groups at the beginning of the study

Indicators	Core group (N=20)	Control group (N=20)	t
VCL, l	$3,87 \pm 0,15$	$3,79 \pm 0,11$	0,73
VI, ml/kg	$47,45 \pm 1,21$	$46,9 \pm 1,44$	0,29

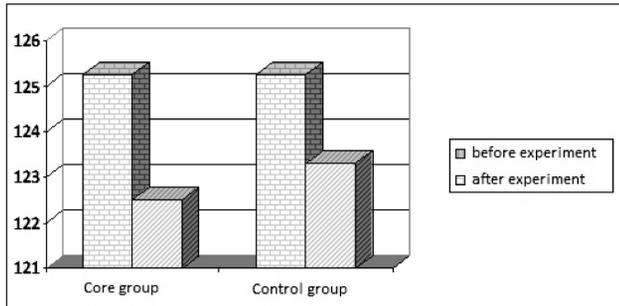
Note: reliability  $p < 0,05$



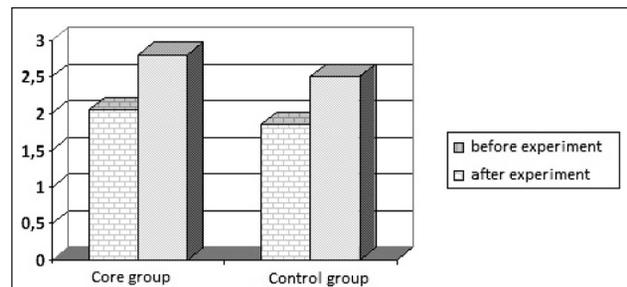
**Figure 1.** The ratio of heart rate before and after the experiment in the core and control groups



**Figure 3.** The ratio of diastolic blood pressure before and after the experiment in the core and control groups



**Figure 2.** The ratio of systolic blood pressure before and after the experiment in the core and control groups



**Figure 4.** The ratio of spinal mobility according to the Schober's test before and after the experiment in the core and control groups

shown (Figure 3) that the indicators of BPD, in the core group before the experiment averaged  $78,75 \pm 1,85$  mm Hg, after the experiment –  $83,1 \pm 1,5$  mm Hg. In the control group, at the beginning of the experiment, these values were  $79,25 \pm 1,82$  mm Hg, after the experiment –  $83,2 \pm 1,6$  mm Hg. At the end of the experiment, we see positive dynamics in both groups, due to adaptation to physical activity.

The data obtained indicate changes in cardiovascular activity, which manifested itself in a decrease in systolic blood pressure and an increase in diastole, a slight increase in heart rate. In the initial study of the elderly in the control group, the indicators of the cardiovascular system were the same as of the patients of the core group. The data obtained indicate that after a course of physical therapy, cardiovascular indicators of patients of both groups improved in comparison to raw data, and, therefore, the proposed course of physical therapy is effective.

When comparing the average indicators of spinal mobility of patients from the core and control groups suffering from osteochondrosis, intergroup differences were not found (Table 2).

Control measurements of spinal mobility and their subsequent ratio showed (Figure 4) that in the core group before the experiment they were  $2,05 \pm 0,17$  cm, after the experiment –  $2,8 \pm 0,12$  cm in the control group, the average indicators before

the experiment were  $1,85 \pm 0,15$  cm, after the experiment –  $2,5 \pm 0,11$  cm. At the end of the study, a positive trend in both groups due to adaptation to exercise, can be seen.

When comparing the average values of spinal mobility of patients suffering from osteochondrosis of the core and control groups according to the modified Schober's test, no intergroup differences were found.

Control measurements of spinal mobility according to the modified Schober's test and their subsequent ratio showed that at maximum flexion (thoracic spine) of patients in the core group before the experiment there were the following results  $1,5 \pm 0,11$  cm, after the experiment –  $2,3 \pm 0,9$  cm. In the control group, the average before the experiment was  $1,6 \pm 0,11$  cm, after the experiment –  $2 \pm 0,1$  cm. It is shown that the average (lumbar area) in the core group, before the experiment was  $5,15 \pm 0,20$  cm, after the experiment –  $5,9 \pm 0,1$  cm in the control group, the average before the experiment was  $5,05 \pm 0,18$  cm, after the experiment –  $5,5 \pm 0,1$  cm. Figure 5 shows that the average values (from C7 to the sacrum) in the core group before the study was  $3,55 \pm 0,11$  cm, after the study –  $4,2 \pm 0,9$  cm in the control group, the average before experiment was  $3,45 \pm 0,11$  cm, after the experiment –  $3,9 \pm 0,1$  cm. At the end of the study a positive trend in both groups, due to adaptation to exercise, can be seen.

**Table 2.** Average indicators of spinal mobility according to the Schober's test of elderly patients with osteochondrosis of the core (N = 20) and control (N = 20) groups at the beginning of the study

Indicators	Core group	Control group	t
Schober's test, cm	$2,05 \pm 0,17$	$1,85 \pm 0,15$	0,88

Note: reliability  $p < 0,05$

**Table 3.** The average indicators of spinal mobility at maximum flexion according to the modified Schober's test of elderly people with osteochondrosis of the core (N=20) and control (N=20) groups at the beginning of the study

Indicators	Core group	Control group	t
Thoracic spine, cm	1,6±0,11	1,5±0,11	0,64
Lumbar area of the spine, cm	5,15±0,20	5,05±0,18	0,40
Segment from C7 to the sacrum, cm	3,55±0,11	3,45±0,11	0,64

Note: reliability  $p < 0,05$

**Table 4.** Average indicators of spinal mobility of elderly people with osteochondrosis of the core (N=20) and control (N=20) groups at the beginning of the study according to Stibor

Indicators	Core group	Control group	t
Extension, %	24,15±0,52	23,65±0,44	0,73
Bent to the left, %	23,6±0,24	23,6±0,28	0
Bent to the right, %	23,65±0,31	23,5±0,28	0,36

Note: reliability  $p < 0,05$

**Table 5.** The average indicators of spinal mobility when turning elderly people with osteochondrosis of the core (N=20) and control (N=20) groups at the beginning of the study

Indicators	Core group	Control group	t
Right bent, °	34,25±0,14	34,2±0,27	0,11
Left bent °	34,25±0,34	34,25±0,35	0,11

Note: reliability  $p < 0,05$

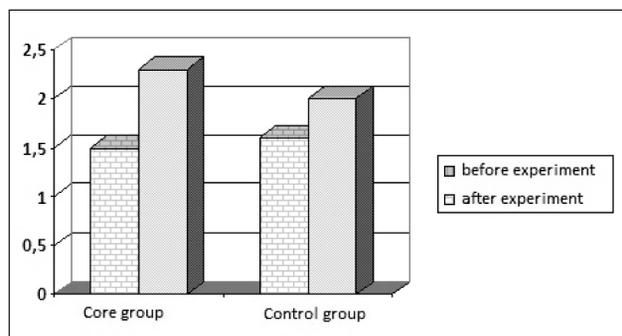
When comparing the average indicators of spinal mobility according to Stibor in patients of the core and control groups suffering from osteochondrosis, no intergroup differences were found (Table 4).

Control measurements of spine mobility according to Stibor and their subsequent ratio showed that when stretching the patients in the core group before the study had the following average values of 24,15±0,52%, after the experiment – 27,5±0,44%. In the control group, the average before the experiment was 23,65±0,44%, after the experiment – 26,7±0,40%. It is shown that when leaning to the left in patients of the core group before the experiment, the average

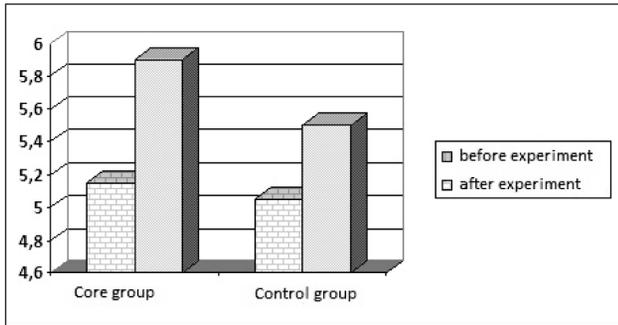
values were 23,6±0,28%, after the experiment – 27,1±0,23%. In the control group, the average before the experiment was 23,6±0,24%, after the experiment – 26,5±0,22%. It was found that when leaning to the right in patients of the core group, the average before the experiment was 23,65±0,31%, after the experiment – 26,7±0,29%. In the control group, these indicators before the experiment were 23,5±0,28%, after the experiment – 26,1±0,25%. At the end of the study, we see positive dynamics in both groups, due to adaptation to physical activity.

When comparing the average indicators of spinal mobility according to Stibor in patients of the core and control groups suffering from osteochondrosis, no intergroup differences were found (Table 5).

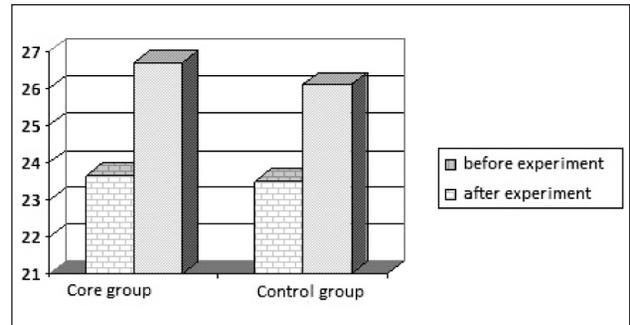
Control measurements of spinal mobility during turns and their subsequent ratio showed that when turning to the right, patients in the core group before the study had the following average indicators of 34,25±0,340, after the experiment – 37,1±0,230. In the control group, the average values before the experiment were 34,2±0,340, after the experiment – 36±0,310. It was demonstrated that the average values when turning left in the core group before the experiment was 34,25±0,290, after the experiment – 37,1±0,280. In the control group, the average indicators before the experiment were 34,25±0,300, after the experiment – 36,5±0,290. At the end of the study, we see positive dynamics in both groups, due to adaptation to physical activity (Figures 6-12).



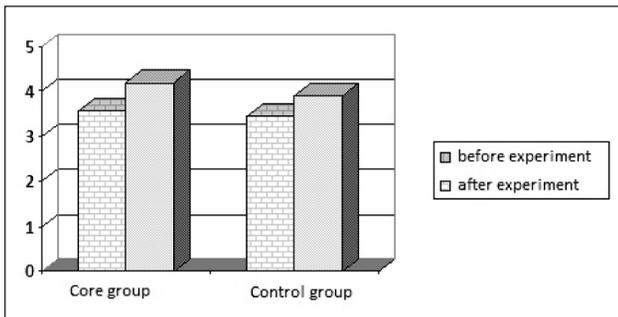
**Figure 5.** The ratio of spinal mobility at maximum flexion according to the modified Schober's test (thoracic spine) before and after the experiment in the core and control groups



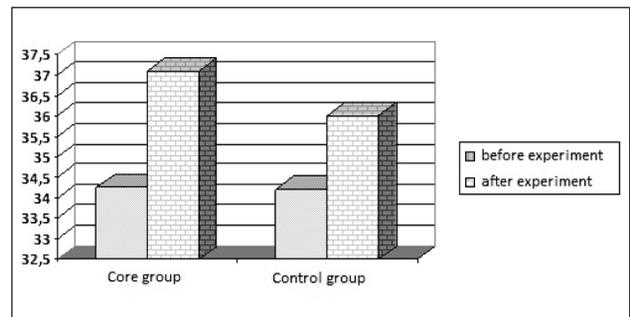
**Figure 6.** The ratio of spinal mobility at maximum flexion according to the modified Schober's test (lumbar area) before and after the experiment in the core and control groups



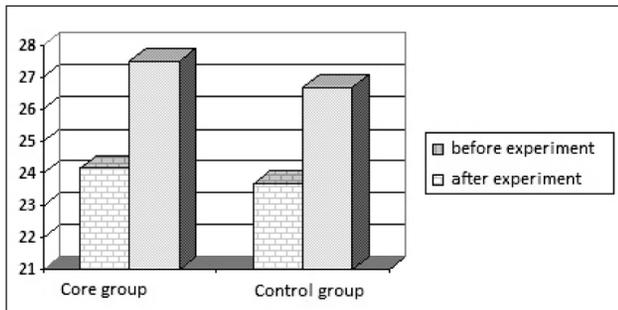
**Figure 10.** The ratio of mobility of the spine according to Stibor (bent to the right) before and after the experiment in the core and control groups



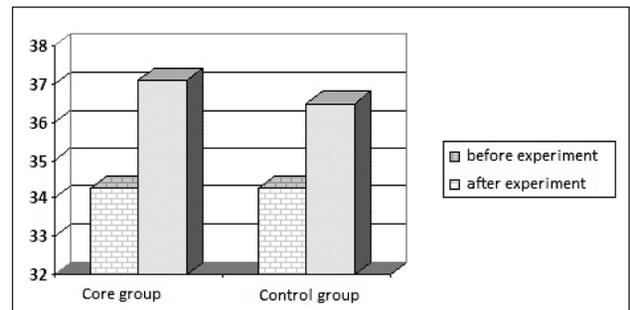
**Figure 7.** The ratio of the mobility of the spine at maximum flexion according to the modified Schober's test (segment from C7 to the sacrum) before and after the experiment in the core and control groups



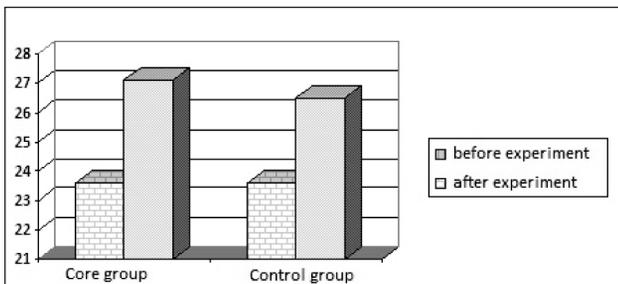
**Figure 11.** The ratio of mobility of the spine (right bent) before and after the experiment in the core and control groups



**Figure 8.** The ratio of mobility of the spine according to Stibor (extension) before and after the experiment in the core and control groups



**Figure 12.** The ratio of mobility of the spine (left bent) before and after the experiment in the core and control groups



**Figure 9.** The ratio of the mobility of the spine according to Stibor (bent to the left) before and after the experiment in the core and control groups

Based on the conducted analysis of the results of the research, an improvement in the mobility of the intervertebral joints of the spine in the elderly in the control and in the core group, was revealed. In the core group, the indicators of mobility of the intervertebral joints increased by 40% from raw data, and in the core group, the indicators rose by 32%. Thus, a significant dynamic in the core group, after physical therapy is observed more, than in the control one. Patients of the core group note the improvement of their physical condition, and, therefore, the proposed rehabilitation complex is effective (Table 6).

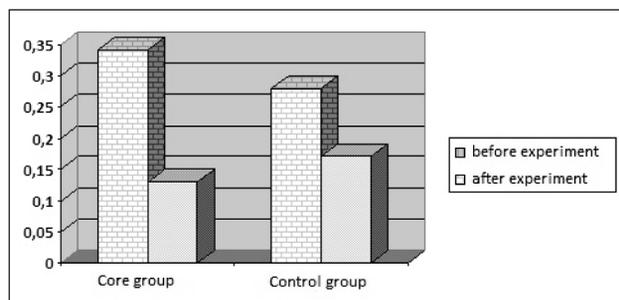
**Table 6.** The average indicators of the questionnaire of elderly people with osteochondrosis of the core (N=20) and control (N=20) groups at the beginning of the study

Core group (N=20)	Control group (N=20)	t
0,34±0,01	0,28±0,01	4,34

Note: reliability  $p < 0,05$

Figure 13 shows the positive dynamics of the results of the questionnaire in the control and core groups. Patients emphasize that after the rehabilitation course, pain has decreased, sleep has improved, they feel more confident, participate more in public life and can better serve themselves at the level of everyday life. The data obtained were represented as a result of a survey of elderly people for the presence of pain in the lumbosacral spine before and after the procedure. In the initial study, the survey data in the experimental and control groups are slightly different. The survey conducted after the experiment shows that the indicators in the core group from the initial changed by an average of 0,21 points, and in the control – by 0,11 points. It should be noted that some patients in both groups report about the presence of pain in the sore area of the spine, but less intense.

Thus, after the developed and traditional rehabilitation complex for osteochondrosis of the spine in the elderly, the pain completely disappeared, thanks to the correct and rational course of rehabilitation.



**Figure 13.** The ratio of the average indicators of the questionnaire in the core and control groups before and after the experiment

## DISCUSSION

The article shows that the proposed complex of rehabilitation measures in the conditions of a sanatorium-resort facility for the elderly significantly contributes to the reduction of pain syndrome, the development of movement qualities and supports the body's functional capabilities at an optimal level, increases their physical activity and significantly reduces pain sensations. Such data are consistent with the results of specialists in physical rehabilitation for osteochondrosis of different parts of the spine, and its positive effect for this contingent of patients has been proven. For example, in the work of Mavazhdeh Sohob [16] indicated that the rehabilitation program helps reduce pain, restore mobility of the lumbar spine, and improve the stability of elderly patients.

Also, during the study, it was noted that the functioning of the physiological systems of the body and the general capabilities of the musculoskeletal system deteriorate in elderly people with osteochondrosis [17].

It was established that there are practically no works that show the use of physical rehabilitation for elderly people with osteochondrosis in the conditions of a health resort.

## CONCLUSIONS

An analysis of the scientific and methodological literature on the problem of the study revealed that the elderly patients with osteochondrosis have deterioration in functioning of physiological systems of the body and the general capabilities of the musculoskeletal system. The question of the possibilities of using non-traditional and modern methods to improve the functional state of this category of people in the conditions of a sanatorium-resort institution is insufficiently studied.

Examination of elderly people with lumbosacral osteochondrosis showed low vital indicators, 20,5% lower than normal, lung vital capacity 17,3%, and blood pressure 11% higher than normal, spinal mobility indicators by various tests showed a significant decrease in motor activity by 18-20%.

The developed set of rehabilitation measures, in the conditions of sanatorium-resort institution, significantly promotes the development of motor skills and maintains the optimal level of functional capabilities of the elderly with osteochondrosis, increases their physical activity and significantly reduces painful feelings by 80%.

Under the influence of the developed set of measures for physical therapy, the efficiency of rehabilitation of elderly people with osteochondrosis significantly increased by all indicators by 30%, under the influence of the traditional complex – by 21%. This gives grounds to recommend the proposed complex for practical use in the system of physical therapy of elderly people with lumbosacral spine in sanatorium-resort institutions.

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#### *Info*

On behalf of the Editorial Board and the Publisher of Acta Balneologica – the official journal of the Polish Society of Balneology and Physical Medicine (published since 1905), we cordially invite you to the new website [www.actabalneologica.eu](http://www.actabalneologica.eu) where, among others, we publish open access articles. We would like to remind you that Acta Balneologica is indexed in the Web of Science (ESCI) as well as EBSCO databases, has 20 MEiN points, and has the permanent patronage of the Rehabilitation Committee of the Polish Academy of Sciences.

At the same time, we encourage you to visit and like the Acta Balneologica profile on Facebook. [facebook.com/actabalneologica](https://facebook.com/actabalneologica). There, we place posts in the field of health resort medicine.

And we will share information about treatment methods available in health resort stations.

A natural consequence of our activities in the field of health resort medicine has been the establishment of the Polish Society of Health Resort Patients in 2019. You can find out more about the goals, tasks, and methods of operation of this Society on the website [www.uzdrowiskowi.pl](http://www.uzdrowiskowi.pl).

You can also download the membership declaration here.

# Modern Principles of Medical Rehabilitation of Patients with Median Defects of the Abdominal Wall

## Współczesne zasady rehabilitacji medycznej pacjentów z wadami w linii pośrodkowej ścian jamy brzusznej

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### SUMMARY

**Aim:** To analyze rehabilitation and improvement of the quality of life of patients with median abdominal wall defects (MAWD) by increasing the efficiency of alloplasty by determining the general principles of planning and performing surgical interventions.

**Materials and methods:** We carried out an analysis of the treatment results of 346 patients with MAWD, who underwent surgery in the 1st Poltava City Hospital for the period 2005-2019. There were 269 women (77.8%), men – 77 (22.2%). 282 (81.5%) patients underwent reconstructive surgeries, 59 (17.1%) – reconstructive and corrective alloplasty techniques, and 5 (1.4%) – corrective ones. Patients underwent surgery: onlay – in 3 patients (0.9%), sublay – in 289 (83.5%), sublay-inlay – in 38 (11.0%), inlay – in 4 (1.2%), Ramirez modification – in 10 (2.9%), open IPOM – in 2 (0.6%).

**Results:** Local complications were in 25 (7.2%) cases: seroma in 12 (3.5%) patients, infiltrate in 5 (1.5%), necrosis of the edges in 4 (1.2%), hematoma – in 3 (0.9%), wound suppuration – in 1 (0.3%). In the remote period, 14 (4.1%) were registered: recurrence – 7 (2.0%); long-term deep seroma – 3 (0.9%); ligature fistulas with phlegmon – 2 (0.6%); abscess formation – 1 (0.3%), hernial sac infiltration – 1 (0.3%).

**Conclusions:** The results of MAWD alloplasty depend on the correct solution of the planning problem and the choice of the most rational treatment tactics. Adequate abdominoplasty leads to an improvement in the quality of life of patients, medical and social rehabilitation.

**Key words:** rehabilitation, planning, alloplasty, median defects, abdominal wall

**Słowa kluczowe:** rehabilitacja, planowanie, alloplastyka, wady linii pośrodkowej, ściana brzucha

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### INTRODUCTION

Despite the development of science, the problem of restorative treatment of patients after various diseases remains open. This is exactly what medical rehabilitation does – a set of measures for medical and therapeutic purposes that aimed at restoring the health of the patient and preventing disability. Nowadays, in conditions of a high level of morbidity among the population and hostilities in Ukraine, the development of medical rehabilitation has the particular relevance [1].

The relevance of the problem is emphasized by the increase in the number of patients requiring abdominoplasty not only for aesthetic reasons, but also for medical and social reasons in combination with the reconstruction of the abdominal wall (AW) for its defects, as well as to eliminate concomitant diseases from the abdominal organs, injuries. Although the restoration of AW functionality is the main goal of alloplasty in MAWD, cosmetic aspects deserve special attention, which are often more important for the patient.

Combined AW defects leave an imprint on the patient's character; affect his personal life, professional function, often lead to the development of a complex of physical, social, psycho-emotional inferiority. Elimination of the AW defects, normalization of the contours of the abdomen, reduction of its size, loss of excess weight due to abdominoplasty helps patients return to a full life.

Reconstruction of MAWD is often a unique, complex problem, since certain anatomical features take place in this localization, but especially with large defects, with loss of tissue resistance, recurrent, complicated, with a history of mesh use or wound infections, in patients with an infected surgical field, with combined defects that are rare [2-4]. The traditional approach to surgical treatment in these cases significantly limits the use of primary alloplasty and sometimes involves a staged treatment component [5-7].

Despite numerous methods of treatment, insufficient attention is paid to an individual, differentiated approach to the tactics

of treating this category of patients. Therefore, the search for new approaches to the planning and features of surgical interventions in patients with MAWD remains relevant.

### AIM

Rehabilitation and improvement of the quality of life of patients with median abdominal wall defects (MAWD), improvement of their ability to work by increasing the efficiency of alloplasty of MAWD by determining the general principles of planning and performing surgical interventions.

### MATERIALS AND METHODS

We carried out a clinical analysis of the consequences of surgical treatment of 346 patients with MAWD who were operated on in an open way in the surgical department of the 1st Poltava city clinical hospital for the period from 2005 to 2019. There were 269 women (77.8%), men – 77 (22.2%). The patients' age ranged from 21 to 85 years (average age was  $62 \pm 3.2$  years). The duration of the disease ranged from 2 months to 47 years. Postoperative MAWD prevailed – 294 (80.8%). Recurrent MAWD was detected in 75 (21.7%) patients. According to the size of the largest defect, they were divided into: W1 – 11 (3.2%), W2 – 226 (65.3%), W3 – 109 (31.5%) episodes.

Accompanying diastases of the rectus abdominis was found in 317 (91.6%) patients. Concomitant diseases were observed in 267 patients (77.2%). Obesity of varying degrees was diagnosed in 218 (63.0%) patients. AW deformity of various origins requiring surgical correction was detected in 253 patients (73.1%).

All patients were examined according to the same scheme, anamnesic, clinical, laboratory, instrumental, intraoperative, morphological factors were determined.

When performing a surgical intervention for MAWD, the following procedures were performed: surgical access to the AW defect with obligatory dermatolipectomy; wide mobilization of the defect edges, handling of the hernial sac (if any); herniolaparotomy (if necessary) for revision, elimination of adhesions, performing simultaneous intra-abdominal operations; alloplasty of the AW; active drainage of the implantation zone; layer-by-layer suturing of the wound and its possible drainage (if necessary).

Types of dermatolipectomies used in patients with MAWD were: according to Bebbcock – 127 (36.7%), longitudinal – 110 (31.8%), according to Fernandez – 69 (19.9%), Fernandez modification – 17 (4.9%), according to Kelly – 11 (3.2%), according to Torek – 6 (1.7%), according to Burson – 4 (1.2%), according to Grazer – 2 (0.6%). 282 (81.5%) patients underwent other types of reconstructive surgeries, 59 (17.1%) patients – reconstructive-corrective alloplasty techniques, and 5 (1.4%) – corrective ones.

Patients with MAWD underwent the following types of alloplasty: onlay – in 3 patients (0.9%), sublay – in 289 (83.5%), sublay-inlay – in 38 (11.0%), "inlay" – in 4 (1.2%), Ramirez modification – in 10 (2.9%), open IPOM – in 2 (0.6%).

To estimate the effectiveness of treatment of patients, first of all, such criteria as postoperative complications, postoperative mortality, and the number of relapses were used.

### RESULTS

In the early postoperative period, local complications were observed in 25 (7.2%) episodes: seroma in 12 (3.5%) patients, inflammatory infiltrate in 5 (1.5%), necrosis of the wound edges in 4 (1, 2%), hematoma – in 3 (0.9%), wound suppuration – in 1 (0.3%). General postoperative complications were noted in 12 (3.5%) episodes: ACS – in 3 (0.9%), PE – in 3 (0.9%), pneumonia – in 2 (0.6%), acute thrombophlebitis of superficial veins of the lower extremities – in 1 (0.3%), parotitis – in 1 (0.3%), acute myocardial infarction – in 1 (0.3%), gastrointestinal bleeding – in 1 (0.3%). 4 (1.2%) patients died. Mortality was mainly associated with the clinical features of comorbidity; only in 1 incident we observed a connection with the method of primary surgery.

In the remote period, 14 (4.1%) local complications were registered: recurrence – 7 (2.0%); long-term deep seroma of the implantation zone – 3 (0.9%); ligature fistulas with recurrent AW phlegmon – 2 (0.6%); abscess formation in the implantation zone – 1 (0.3%), hernial sac infiltration – 1 (0.3%).

### DISCUSSION

At present, in the case of surgical closure of the MAWD, alloplasty of the AW has convincingly become the main operation [6-8]. Improved alloplasty techniques using surgical meshes can successfully eliminate the most AW defects and expand the limits of their operability [4-6, 9]. But, unfortunately, there are significant differences in indications for implantation, in the choice of alloplasty technique, surgical access, mesh formats, methods of their fixation, and prediction of consequences. Considering the imperfection of surgical methods, alloplasty materials, and patients, the success of the operation for the closure of MAWD may be questionable. Favorable results of surgery for MAWD also depend on the type of implanted material, its location, fixation [2, 9, 10].

The choice of alloplasty was obviously dependent on the area of the defect, its size, shape, morphological state of the AW tissues, the possibility of suturing them without significant tension, creating the optimal volume of the abdominal cavity, and the likelihood of postoperative complications. The following were also taken into account: the severity of diastases of the rectus abdominis muscles, the degree of tissue deficiency of the anterior abdominal wall (DTDAAW), the degree of intra-abdominal pressure (DIAP) before and after the operation, the characteristics of the personal clinical situation [6].

Taking into account the size of the defect, DTDAAW, in patients with MAWD, allowed the differential use of the AW reconstructions or corrections depending on the technical conditions and the level of DIAP, which was measured under conditions of modeling the state of the abdominal cavity, as after alloplasty. With the growth of DIAP, after the erection of the edges of the defect, up to 15-30% of the original, it was considered possible to perform alloplasty using the "sublay" method, up to 45% – "sublay-inlay", and with more than 45% – special methods of AW alloplasty without reduction volume of the abdominal cavity.

When planning apoplectic reconstructive operations associated with extensive mobilization of tissue flaps to close adjacent AW defects, the limits of the anatomical and

physiological possibilities of plastic deformation of all tissue structures in this zone were taken into account. To reduce tissue tension in MAWD alloplasty, wider surgical approaches, stratification, separation of anatomical components, and mobilization of tissue flaps of different thicknesses within their anatomical and physiological capabilities were used. Maximum attention was paid to the state of regional hemo- and lymphatic circulation, preservation of peripheral nerves, elastic-deformation and strength properties of the AW tissues.

The goal of every plastic surgery is to renew the form and function of this area. Considering that in certain parts of the AW there is a complex anatomical structure, during the reconstruction, their structure should, if possible, approach the primary one. Only under such conditions can one hope for an approach to the ideal restoration of the form and function of the destroyed parts of the AW. Therefore, we believe that a complete closure of the MAWD is best done by separating the anatomical components and extensive mobilization of the AW tissues.

When planning a reconstructive operation for MAWD in each specific case, these points were adhered to: 1) used the division of tissue components of the AW into predominantly dynamic and supporting ones; 2) the dynamic function is performed by skin-subcutaneous-fascial flaps and muscles; 3) the main supporting tissue structures are fascial (aponeurotic) nodes and periosteum of the pelvic bones, ribs; 4) AW alloplasty was performed according to the principle of minimum deformation of sliding tissue complexes with fixation of the alloplasty material to the supporting structures; 5) all surgical interventions should be performed within the physiological capabilities of maximum plastic deformation of sliding tissue complexes, taking into account the depth, limits of their detachment and mobilization, and the strength properties of supporting structures, depending on the characteristics of various topographic and anatomical areas of the AW.

Assessing the possibilities of the most optimal location of the implant in the thicknesses of the AW, it was necessary to take into account its physical and mechanical properties, the degree of tension, that is, tissue tension. In MAWD alloplasty, attempts were made to position the mesh implant (MI) so that its greatest rigidity approached the characteristics of the musculoaponeurotic structures of the AW in patients in the defect area that needed to be strengthened. The main criteria for the choice of the AW that affect the effectiveness of alloplasty were considered: type, specific gravity of the polymer, cell size, anisotropy level, which made it possible to maximally individualize the choice of implant and to plan the type of alloplasty taking into account the characteristics of the patient.

Also, the main features of alloplasty in the mobilization of dynamic structures of soft tissues of the AW were developed, what came down to: 1) determining the strategy for updating the AW for each individual incident should depend on the existing anatomical features of the alloplasty zone, the size and shape of the defect, its location, morphological changes in the AW tissues, gender, age, degree of obesity of the patient, clinical features; 2) the formation of a "base" for the implant by separating the anatomical structures and their stratification within the limits of plastic deformation; 3) the separation of anatomical

components and the limits of their mobilization are established in relation to the biomechanical properties of one or another topographic anatomical site and individual morphological changes in tissue complexes; 4) the use of component separation of the AW tissues is performed for better approximation of the edges of the defect without tension and increase in DIAP; 5) adherence to the principle of the AW augmentation, that is, "bridging" – bridge-like overlapping of the defect - depending on the clinical situation, the operation can be reconstructive, reconstructive-corrective or corrective; 6) the method of MI fixation depends on the boundaries of detachment, mobilization of tissue complexes, method of alloplasty, type and size of the implant; 7) taking into account the topographic anatomical site of localization and prevalence of the AW defect, the selected appropriate the AW is fixed to suitable supporting tissues (fascial node or periosteum); 8) when the skin-subcutaneous flap is not mobilized, the AW fixation is performed transfascially using interrupted submersible sutures, taking into account the maximum allowable deformation of the implant, and modeling an adequate DIAP; 9) the number of fixing seams that hold the maximum static stress may vary depending on the size, shape and location of the measuring instrument; 10) suturing of the mobilized fasciocutaneous flap together with subcutaneous adipose tissue is carried out with thick interrupted sutures with fixation to the aponeurosis to minimize residual cavities (using PTS-technic).

During alloplasty of MAWD, in order to achieve a verified result and minimize complications, the following principles were observed during the operation: 1) in case of cicatricial defects, a revision with alloplasty of the zone of the entire postoperative scar was performed; 2) the posterior sheets of the rectus muscles were widely mobilized along the linea alba on both sides along the upper and lower edges of the AW defect; 3) in the presence of diastases of the rectus abdominis muscles, the aponeurotic sheaths were cut from the xiphoid process almost to the pubic fusion; 4) with multiple AW defects, they were combined, forming one common defect in the longitudinal direction, corresponding in shape to an ellipse; 5) after opening the sheaths of the rectus abdominis muscles from the edges of the defect, the maximum possible mobilization of the retromuscular space was performed in the lateral direction to the Spigelian lines; 6) when mobilizing tissue complexes of the abdomen to the lateral sides of the defect, we tried to preserve the nerves and vessels of the AW as much as possible; 7) when choosing the method of AW alloplasty, DIAP was measured when modeling the closure of the abdominal cavity, as after alloplasty; 8) with defects W3, expressive cicatricial changes in the site of alloplasty, dissociation of the lateral anatomical structures of the AW was performed; 9) in the presence of cicatricial changes or with atrophic changes in the muscular- aponeurotic tissues of the AW, not capable of performing the technology with dissociation of the anatomical components of the abdomen, the IPOM technique was used; 10) after measuring the dimensions of the implantation site, cut out the required shape and size of the MI; 11) sufficiently covered with the implant (at least 6-8 cm) the AW tissues along the perimeter of the defect in all directions; 12) the area of the implant must exceed the area of the AW defect by at least 1.6 times (factor 0.7

- compliance with the Fibonacci principle); 13) when applying alloplasty of the AW using the “sublay-inlay” technique, the AW with average cell sizes and moderate anisotropic properties were used; 14) when performing AW alloplasty using the “inlay” technique, they tried to use the AW with small cell sizes and orthotropic qualities; 15) in standard AW alloplasty with a distinct anisotropy, the MI must have greater vertical strength, or use implants which strength in the vertical direction corresponds to that in the horizontal; 16) in corrective AW alloplasty the AW must have greater strength in the vertical direction; 17) maximally prevented contact of the AW with the intestines; 18) the implant was necessarily fixed along the perimeter to the supporting AW tissues; 19) performed the maximum possible reconstruction of the linea alba as a medial fulcrum for all musculoaponeurotic structures of the AW.

So, analyzing the features of the modified methods of surgical interventions and their consequences, it can be argued that the principle of maximum mobilization of sliding shells has been developed, taking into account the biomechanical features of soft tissues and their topographic anatomical, histological structure, which makes it possible to expand the reserves of alloplasty operations with the slightest complications, scars, optimal functional and aesthetic result.

In our opinion, the term abdominoplasty has a broader meaning than it has been thought. Correction of abdominal deformities of various origins is an urgent medical and social problem. The use of the technique developed by us made it possible to achieve not only the maximum aesthetic effect, but also significantly reduce the number of postoperative complications.

An analysis of the quality of life of patients after surgery found an improvement in vitality, role-playing emotional functioning and psychological health in the study groups ( $p < 0.05$ ).

## CONCLUSIONS

The consequences of MAWD alloplasty depend on the correct solution of planning issues and the choice of the most rational treatment tactics. To improve the results of treatment, one should focus on a personal assessment of the patient's condition and the choice of rational surgical tactics during the operation. The individuality of each patient requires a differentiated approach to the selection of the optimal treatment technology. Elimination of the AW defects, normalization of the contours of the abdomen, reduction of its size due to adequate abdominoplasty leads to an improvement in the quality of life of patients, their professional function, medical and social rehabilitation.

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A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical review of the article, F – Final approval of article

# Efficacy of Platelet-rich Fibrin in the Treatment and Rehabilitation of Patients with Peri-implant Mucositis

## Skuteczność fibryny bogatopłytkowej w leczeniu i rehabilitacji pacjentów z zapaleniem błony śluzowej wokół implantu

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### SUMMARY

**Aim:** To evaluate the effectiveness of injectable platelet-rich fibrin (i-PRF) in the complex treatment and rehabilitation of patients with peri-implant mucositis.

**Materials and Methods:** Clinical examination and treatment of 23 patients with peri-implant mucositis were carried out. Patients of the main group (n=11) were injected with liquid platelets-rich fibrin. In patients of the control group (n=12) the treatment protocol involved local antibacterial and anti-inflammatory therapy. The assessment of peri-implant tissues condition was performed on the basis of visual inspection, generally accepted instrumental and X-ray examination and was based on the data of periodontal tests and indexes.

**Results:** In 72.7% of patients after i-PRF usage, reduction of inflammation was observed on the 3rd day of treatment; on the 7th day the clinical status corresponded to the norm. At the same time, in the control group a decrease of inflammation signs was revealed only in 33.3% of patients on the 3rd day and in 66.7% on the 7th day; complete elimination of inflammation in all patients was registered on the 14th day of observation. In 12-month follow-up examination the positive dynamic of peri-implant mucositis treatment was maintained in 81.8% of patients of the main group and in 50.0% of patients of the control group.

**Conclusions:** The use of i-PRF in the complex treatment of peri-implant mucositis contributes to the rapid elimination of inflammation signs and bleeding of the gums surround the implants, accelerates the soft tissues regeneration, shortens treatment times and provides long lasting stabilization of the process.

**Key words:** dentistry, dental implant, peri-implant mucositis, treatment, platelet rich fibrin

**Słowa kluczowe:** stomatologia, implant zębowy, okołointplantowe zapalenie błony śluzowej, leczenie, fibryna bogatopłytkowa

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### INTRODUCTION

Non-compliance with the rules of rational prosthetics and hygienic care of implants contributes to the accumulation of biofilm on the implant superstructure and the development of a chronic inflammatory process in peri-implant tissues, which leads to peri-implant mucositis and peri-implantitis. Peri-implant mucositis has been defined as an inflammatory lesion of the mucosa surrounding dental implant, whereas peri-implantitis – is an inflammatory-destructive lesion that affects the surrounding mucosa with loss of supporting peri-implant bone or continuing marginal bone [1, 2]. The prevalence of peri-implant tissue diseases is quite high: peri-implant mucositis varies from 32 to 54% at different times after implantation, peri-implantitis – from 12 to 43% [1, 3, 4]. Long-term chronic inflammation in the peri-implant zone is the cause of the destruction and resorption

of bone structures in the implant region, the appearance of peri-implantitis with a progressive nature of its course, resistance to treatment, a tendency to recurrences, that negatively affects the functioning of orthopedic superstructures on the implants and subsequently lead to their loss [5]. That is why prevention and treatment of inflammatory and destructive complications of dental implantation should be carried out in the early stages of peri-implant mucositis formation.

In the treatment of diseases of peri-implant tissues, in addition to mechanical cleaning, promising is the use methods based on the activation of reparative regeneration processes of tissue structures [6-8]. The essence of i-PRF technique is to inject liquid fibrin into the gums around the implant, which provides a long-lasting anti-inflammatory effect and stable remission of the disease [9, 10].

## AIM

To evaluate the effectiveness of injectable platelet-rich fibrin (i-PRF) in the complex treatment and rehabilitation of patients with peri-implant mucositis.

## MATERIALS AND METHODS

A clinical examination and treatment of 23 patients aged 30-50 years with peri-implant mucositis, which occurred in 6 months or more after placing dental implants, were carried out. Patients were divided into 2 groups: the main (n=11) and control (n=12). Patients with destructive forms of periodontal diseases, occlusal disorders, bruxism, TMJ pathology, systemic diseases, after radiation therapy in the head and neck were excluded from the study.

The clinical examination included collecting complaints, detailing an anamnesis, determination of hygienic condition of oral cavity and the condition of soft tissues in the peri-implant zone. The study was performed on the basis of a visual inspection, generally accepted instrumental and X-ray examination and was based on the data of periodontal tests and indexes.

Plaque accumulation around existing implants was determined using the plaque index adapted for dental implants (Modified Plaque Index [mPI]; Mombelli, Van Oosten, Schurch, & Land, 1987). The activity of the inflammatory process was assessed using the gingival index (Modified Gingival Index [mGI]) and the bleeding index (Modified Sulcus Bleeding Index [mSBI], modified for dental implants (Mombelli et al., 1987). The depth of gingival attachment to the implant was recorded using periodontal probe UNC 15.

In both groups of patients, the treatment included: elimination of local irritating factors, professional oral hygiene, scaling with Hu-Friedy titanium curettes, polishing of the implant surface with glycine, training in individual oral hygiene and its control, choosing of hygiene products. Patients of the control group were treated with local antibacterial and anti-inflammatory therapy, which included rinsing with 0.12% Chlorhexidine mouth rinse, twice daily and application of Cholisal gel ("ELFA A.T"; Poland) 2 times a day for 7-10 days. Patients of the main group were injected with platelet-rich fibrin (i-PRF), which was obtained by centrifuging the venous blood of patients without anticoagulants in special i-P tubes (Figure 1). For the formation of i-PRF, the centrifugation speed was 700 rpm, and the time was 3 min. The course of treatment included 1 injection after professional oral hygiene and, if necessary, 1 injection on the 7th day of treatment (Figure 2).

The clinical effectiveness of the proposed method was assessed before, on the 3rd, 7th and 14th day of treatment. The stability of the proposed treatment was confirmed by clinical and radiological methods in 12 months of follow-up dispensary observation. Statistical analysis of the research results was carried out using Microsoft® Excel 2017 computer programs for Mac and "Statistica 6.1". Statistical data processing was performed by methods of variation statistics with the calculation of average arithmetic and relative values and errors ( $M \pm m$ ), ( $P \pm m$ ), standard deviation ( $t$ ) and the significance of differences ( $p$ -value, the differences were considered statistically significant at  $p < 0.05$ ). In the case of confirmation of the normal



Figure 1. Blood serum and leukocyte-platelet clot after centrifugation in 10.0 ml tubes

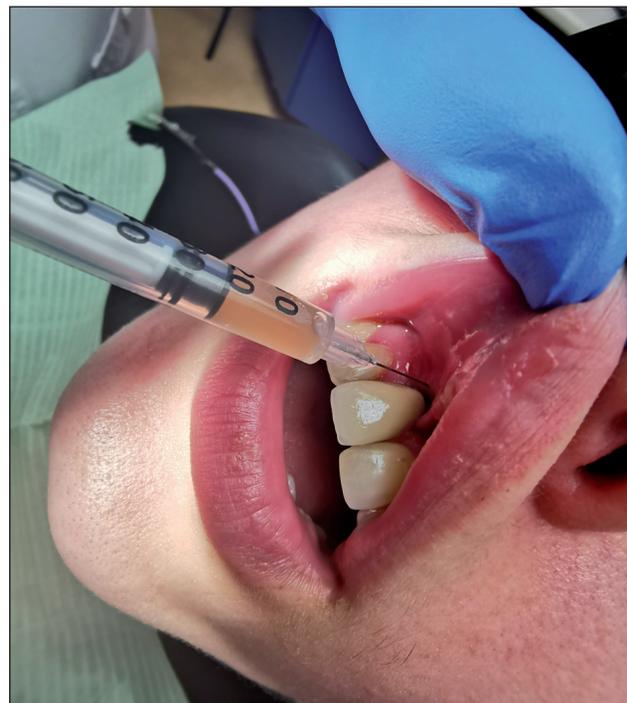


Figure 2. Administration of i-PRF Injectable Concentrate

distribution law when comparing quantitative indicators between groups, we used parametric methods – Student's t-test for independent variables, and to identify differences in dynamics during therapeutic measures, Student's t-test for dependent variables.

The research was carried out in compliance with the main provisions of the “Rules of Ethical Principles of Scientific Medical Research Performing with Human Participation”, approved by the Declaration of Helsinki, ICH GCP, EU Directive № 609, orders of the Ministry of Health of Ukraine № 690 dated 09/23/2009, № 944 dated 12/14/2009, № 616 dated 08/03/2012. The research protocol was approved by the Biomedical Ethics Committee of National Pirogov Memorial Medical University, Vinnytsya.

## RESULTS

Before treatment, the patients of both groups complained of slight pain, bleeding, and periodic swelling of the gums around the implant-supported orthopedic superstructures. During objective examination the moderate redness, slight edema and bleeding of the soft tissues in the peri-implant zone were revealed (Figure 3a, 3b).

Friability and pastiness of the gingiva, pain of the gums on palpation and in some clinical cases the presence of granulations were observed, which indicates a long course of chronic inflammatory process in the peri-implant zone. In patients of the main and control groups, the implants were sufficiently osseointegrated and immobile.

According to X-ray data, no changes were revealed in the bone surrounding the dental implants. The results of the index assessment and periodontal status of patients in the studied groups before treatment were as follows: mSBI –  $1.65 \pm 0.14$  scores; mGI –  $1.35 \pm 0.17$  scores, mPI –  $1.74 \pm 0.16$  scores, which indicated a high activity of the inflammatory reaction in the gums in the peri-implant zone and a low level of oral hygiene.

The results of the treatment of peri-implant mucositis have been shown better therapeutic effect in patients of the main group compared to the control one already on the 3rd day of treatment: after the use of i-PRF in 72.7% of the examined

patients, the discomfort in the gums and pain were decreased, bleeding and hyperemia of the gingival margin were not observed. 3 patients were re-injected with i-PRF on the 7th day of treatment. At that time, in the control group on the 3rd day of treatment only in 33.3% of subjects the reduction of inflammation signs was revealed.

On the 7th day in the main group of patients the clinical manifestations corresponded to the norm: the oral mucosa acquired a pale pink color, a tight fit of the gingival tissues to the implant neck was revealed (Figure 4a, 4b). In these patients, low indices of mPI, mGI and mSBI were determined, which indicated a good oral hygiene, the absence or low activity of the inflammatory reaction in the gingival tissue of peri-implant zone.

A similar clinical condition in the control group on the 7th day of treatment was achieved in 66.7% of patients. Complete elimination of inflammation in patients of the control group was diagnosed on the 14th day of observation.

The results of the indexes assessment in patients of the studied groups in different periods of dynamic observation are shown in Table 1. As can be seen from the above data, in patients of both groups an improvement of mPI values on the 3rd, 7th, and 14th days of the examination was revealed, with the exception of the 12-month follow-up period, that are explained by the lack of professional hygiene. A significant decrease of hygiene index values in patients of both groups is explained by the performed professional oral hygiene, as well as the training of individual hygiene, the choosing dental care products and the provided recommendations for hygiene maintain. Worsening of mPI values in a year can be explained by unscrupulous implementation of the dentist's recommendations in the absence of control.

Similar results were observed during the analysis of the mGI: a significant decrease in the values of the index in different periods of observation compared to the baseline. At the same time, in the patients of the main group the values of mGI in a year of



Figure 3a, 3 b. Peri-implant mucositis clinical and radiographic presentation (before treatment)

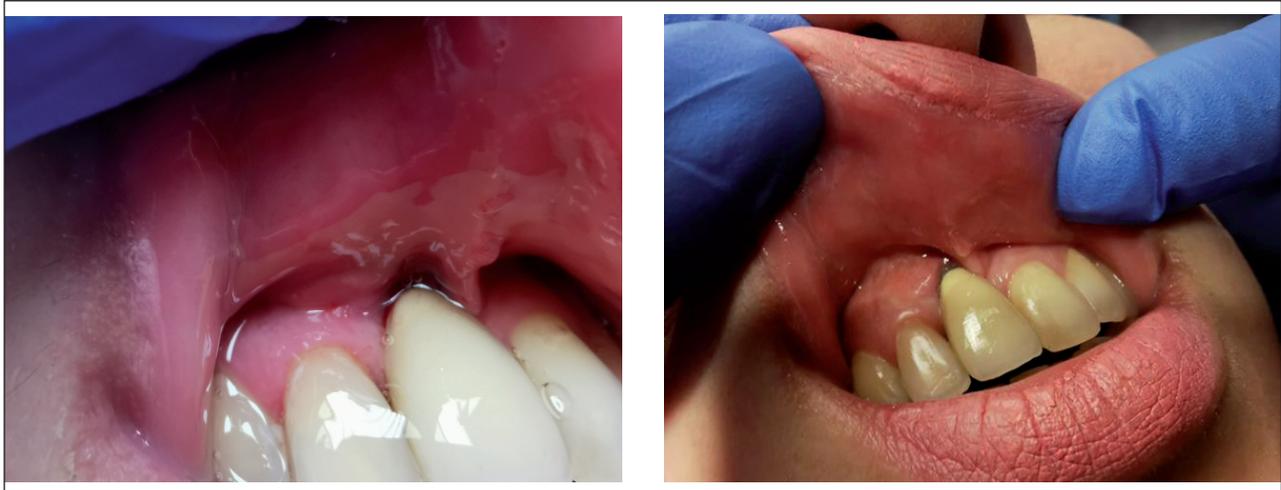


Figure 4a, 4b. Peri-implant mucositis clinical presentation (after treatment)

Table 1. Index assessment of peri-implant tissues condition during mucositis treatment

Indexes	mSBI (scores)		mGI (scores)		mPI (scores)	
	Main group	Control group	Main group	Control group	Main group	Control group
Terms of observations						
Before treatment	1.64±0.21	1.66±0.20 $p_1 > 0.05$	1.36±0.29	1.33±0.20 $p_1 > 0.05$	1.73±0.25	1.75±0.23 $p_1 > 0.05$
3rd day of treatment	0.64±0.21 $p < 0.01$	0.83±0.28 $p < 0.05; p_1 > 0.05$	0.45±0.22 $p < 0.05$	0.67±0.23 $p < 0.05; p_1 > 0.05$	0.36±0.16 $p < 0.001$	0.33±0.15 $p < 0.001; p_1 > 0.05$
7th day of treatment	0.36±0.16 $p < 0.001$	0.58±0.24 $p < 0.01; p_1 > 0.05$	0.27±0.15 $p < 0.01$	0.42±0.16 $p < 0.01; p_1 > 0.05$	0.36±0.21 $p < 0.001$	0.42±0.20 $p < 0.001; p_1 > 0.05$
14th day of treatment	0.18±0.13 $p < 0.001$	0.33±0.15 $p < 0.001; p_1 > 0.05$	0.09±0.10 $p < 0.001$	0.17±0.12 $p < 0.001; p_1 > 0.05$	0.45±0.22 $p < 0.01$	0.67±0.23 $p < 0.01; p_1 > 0.05$
12 months after treatment	0.55±0.17 $p < 0.01$	1.25±0.23 $p > 0.05; p_1 < 0.05$	0.36±0.21 $p, p_1 < 0.05$	1.08±0.20 $p > 0.05; p_1 < 0.05$	0.91±0.36 $p > 0.05$	1.17±0.31 $p, p_1 > 0.05$

Note:  $p$  – the significance of the difference between the index values before treatment and at different periods of dynamic observation;  $p_1$  – the significance of the difference between the values of the index of the main and control groups; mSBI: 0 – absent of bleeding, 1 – bleeding to isolate spot, 2 – linear bleeding, 3 – spontaneous and profuse bleeding; mGI: 0 – normal mucosa, 1 – edema, 2 – edematous and polishes mucosa, 3 – marked redness, edema, spontaneous bleeding; mPI: 0 – absence of plaque, 1 – plaque detectable with probe, 2 – visible plaque, 3 – presence of abundant plaque deposits.

observation were significantly lower ( $0.36 \pm 0.21$  scores) than in subjects of the control group ( $1.08 \pm 0.20$  scores,  $p_1 < 0.05$ ).

Bleeding on probing is an important parameter in the diagnosis of mucositis. The tendency of decreasing in the mSBI was observed among patients who participated in the clinical study, that correlated with the results of mPI and mGI. The performed periodontal procedures significantly reduced the values of mSBI. Along with that, the mSBI values were differed among patients of both groups in a year of dynamic observation: in the main group of patients, the values were significantly lower ( $0.55 \pm 0.17$  scores) than in the control group ( $1.25 \pm 0.23$  scores,  $p_1 < 0.05$ ).

When analyzing the results of probing the gingival attachment in patients of the main group, the indicators of the depth of the gingival attachment were not changed in a year of observation, in the control group they were worsened by 0.1 mm ( $1.2 \pm 0.1$  mm at baseline up to  $1.3 \pm 0.2$  mm in 12-month follow-up evaluation).

## DISCUSSION

I-PRF technology is a technique for obtaining autogenous material from the patient's own blood with a high content of all forms of leukocytes and platelets, which slowly releases growth factors, improving tissue regeneration during treatment [9, 10].

The injectable blood concentrate i-PRF enhances bone metabolism and angiogenesis, possesses anti-inflammatory, osteoinductive and local immunomodulating effects [10, 11]. Platelet-enriched fibrin PRF contains: platelets – 100%, leukocytes – 60%, natural fibrin. Due to intense stimulation of progenitor cells, leukocytes contribute to bone synthesis and cause the transformation of monocytes into macrophages. According to studies [9, 11, 12], platelets and leukocytes can secrete growth factors only after the formation of a fibrin clot, because only fibrin is able to give them therapeutic potential.

When using i-PRF in the complex treatment of peri-implant mucositis, patients of the main group had better therapeutic effect compared to patients of the control group, in which

the standard treatment algorithm was used. Thus, on the 3rd day after the start of the treatment in the patients of the main group the pain and discomfort in the gums were reduced, the bleeding and hyperemia of the gingival margin were decreased, and the serous discharge from the treated areas was stopped. As early as the 7th day of the treatment, it was possible to achieve complete elimination of inflammation in the peri-implantation zone in 81.8% patients. The data of the clinical examination were confirmed by significantly lower values of index assessment of the hygienic and periodontal status of oral cavity compared to baseline.

Under the influence of therapeutic complexes in patients of the control group, positive dynamics of clinical and paraclinical indicators of gum condition around actively functioning orthopedic structures on implants were revealed up to the 7th day of treatment; complete elimination of inflammation was achieved in most patients by the end of the second week.

In general, in the main group of patients the duration of treatment was  $7 \pm 01$  days. The achievement of a similar clinical status in patients of the control group was delayed by 3-4 days. This significant ( $p < 0.05$ ) difference is caused by the drop-by-drop release of growth factors from PRF over 7 days. Due to the long-term release of growth factors, i-PRF promotes rapid regeneration of the gums and bone [11, 12].

The high therapeutic efficiency of i-PRF is confirmed by the results of follow-up observation: the clinical effect obtained immediately after peri-implant mucositis therapy and in 12 months of observation was maintained in a large number of patients of the main group than in the control group by 31,8%.

The use of i-PRF for treatment of mucositis and prevention of peri-implantitis provided a faster regression of clinical symptoms of dental mucositis (for 3-4 days), normalization of indicators of hygienic and periodontal status, long-lasting stabilization of the process (81.8% of patients) than with traditional treatment.

## CONCLUSIONS

The use of i-PRF in the complex treatment of peri-implant mucositis contributes to the rapid elimination of inflammation signs and bleeding of the gums surround the implants, accelerates the soft tissues regeneration, shortens treatment times and provides long lasting stabilization of the process.

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## Conflict of interest:

The Authors declare no conflict of interest

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# Experience of the Use of Photodynamic Therapy in the Treatment of Chronic Traumatic Lesions of Oral Mucosa

## Doświadczenie w zastosowaniu terapii fotodynamicznej w leczeniu przewlekłych pourazowych zmian błony śluzowej jamy ustnej

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### SUMMARY

**Aim:** To evaluate the therapeutic effectiveness of the use of photodynamic therapy in chronic traumatic lesions of oral mucosa.

**Materials and methods:** Clinical examination and treatment of 67 patients aged 18-65 years with erosive-ulcerative lesions of oral mucosa were carried out. Treatment of patients in the main group was performed using photodynamic therapy. Treatment of patients of the control group was carried out according to the standard method. The results of treatment were evaluated by clinical and cytological parameters.

**Results:** In all patients of the main group with chronic traumatic erythema, already on the second day of treatment, complaints of pain when talking and eating completely disappeared, and on the third day in 100% of patients the affected mucosa had no pathological changes. In patients with erosive-ulcerative lesions, complete clinical recovery in the main group was observed on the 3-4th day of treatment, in the control group – on the 7-10th day. The results of cytological examination, namely the absence of young epithelial cells of stages 1 and 2 of differentiation, a significant decrease of intermediate maturity cells (stages 3 and 4) and a similar increase of mature cells (stages 5 and 6), indicated the acceleration of mucosal regeneration in patients of the main group compared to the control group.

**Conclusions:** The use of photodynamic therapy in the treatment of traumatic oral mucosa lesions contributed to the acceleration of elimination of clinical manifestations of chronic mechanical injuries and the normalization of parameters of cytological characteristics of epithelial cells in patients of the main group compared to the group of standard treatment.

**Key words:** photodynamic therapy, traumatic lesions, oral mucosa, cytological research

**Słowa kluczowe:** terapia fotodynamiczna, zmiany pourazowe, błona śluzowa jamy ustnej, badania cytologiczne

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### INTRODUCTION

Despite certain achievements in the treatment and prevention of chronic traumatic lesions of the oral mucosa, the search for more advanced and effective methods of treatment continues. One of the perspective directions for solving this problem is photodynamic therapy (PDT), which is based on the use of low-intensity laser radiation and substances – photosensitizers [1, 2]. Numerous scientific studies indicate the complex action of laser light, that under certain conditions causes many biochemical processes in the body: it blocks the inflammatory process, helps to clean erosive foci from the products of tissue decay, reduces the content of inflammatory mediators in the affected areas, improves metabolic and reparative processes [3-6]. Because the mechanism of PDT action is due to free-radical reactions occurring in the tissues with accumulated photosensitizer,

the process has a local character, limited by radiation zone and has no systemic effect. Another advantage of PDT is the ability to reduce the pathogenicity of the microflora and increase its sensitivity to the action of antibacterial drugs, as well as the absence of the development of microbial resistance and microbiocenosis disorders [7, 8]. Taking into account the availability of pathological focus on the oral mucosa for laser radiation, it is advisable to use it for PDT in the treatment of erosive-ulcerative lesions. An important role in improving treatment of oral mucosa diseases is played by the use of methods of adequate control over the effectiveness of treatment measures. In this direction, it is promising to use a cytological method that provides objective information about the morphofunctional state of oral mucosa in its lesions of various types and in the dynamics of treatment [9].

## AIM

To evaluate the therapeutic effectiveness of the use of photodynamic therapy in chronic traumatic lesions of oral mucosa.

## MATERIALS AND METHODS

Clinical examination and treatment of 67 patients aged 18-65 years with traumatic lesions of the oral mucosa were carried out. Among them, in 35 patients the chronic traumatic erythema was diagnosed, in 19 patients – traumatic erosion, and in 13 patients – decubitus ulcer. The patients were divided into two groups: the main group (n=32) and the control one (n=35). In both groups treatment was stated with the elimination of traumatic factors. The patients of the main group underwent with non-contact laser radiation of the affected areas with the Picasso diode laser “AMD Lasers” (USA) with a wavelength of  $940 \pm 15$  nm in a constant mode with a power range of  $0.5 \text{ W/cm}^2$  when using non-activated fiber “Program 4” [10]. Exposure was 2 minutes on each zone, number – 5 procedures daily. As a photosensitizer, a 0.1% aqueous solution of methylene blue was used, which exhibits antiviral, antibacterial, and antifungal effects and has a minimal damaging action on the cells of oral mucosa. Treatment of the control group included rinsing with Paroex 0.06% solution for 1 minute 2 times per day, application of Cholisal gel and sea buckthorn oil for 20 minutes 2 times per day.

Cytological research methodology and its assessment were carried out according to the recommendation by GV Banchenko et al. [8]. Mathematical processing of cytograms was determined by the formula:  $\text{IDC} = 1a + 2b + 3c + 4g + 5d + 6e$ , where IDC – the cell differentiation index; 1-6 – digital values of the degree of cells differentiation, a-e – the percentage of cells corresponding to the maturation stage.

The analysis of statistical data was carried out using the method of the Student's t-test according to the principle of variation statistics. Values of  $p < 0.05$  were considered statistically significant.

The research was carried out in compliance with the main provisions of the “Rules of Ethical Principles of Scientific Medical Research Performing with Human Participation”, approved by the Declaration of Helsinki, ICH GCP, EU Directive № 609, orders of the Ministry of Health of Ukraine № 690 dated 09/23/2009, № 944 dated 12/14/2009, № 616 dated 08/03/2012. The research protocol was approved by the Biomedical Ethics Committee of National Pirogov Memorial Medical University, Vinnytsya.

## RESULTS

During the clinical examination, in 35 patients with chronic traumatic erythema the edema and hyperemia of the oral mucosa were revealed. Localization of lesions corresponded to the action of an irritating factor (Figure 1). Regional lymph nodes in 6 (17.1%) of cases were enlarged, mobile, not fixed with underlying tissues and painful on palpation.

Clinical manifestations of chronic traumatic erosion, which were diagnosed in 19 patients, were characterized by swelling and hyperemia of the mucosa with single erosions of an oval shape, covered with a fibrinous slough, sharply painful. Lymph nodes in 68.4% of patients were enlarged and painful on palpation.



Figure 1. Patient Z. Diagnosis: Chronic traumatic erythema of oral mucosa before treatment



Figure 2. Patient P. Diagnosis: Decubitus ulcer before treatment

A decubitus ulcer was diagnosed in 13 patients. All patients complained of pain, increased when eating and using removable dentures (Figure 2). In these patients the submandibular lymph nodes were enlarged and painful on palpation.

Positive dynamics of clinical symptoms of the disease after performed treatment was revealed in both studied groups. Thus, in 17 (100%) of patients of the main group with chronic traumatic erythema, after the elimination of the irritating factor already on the second day of treatment, complaints of pain when talking and eating completely disappeared, in 9 (52.9%) of patients there were no swelling and hyperemia on the affected surface. On the third day of treatment, in 100% of patients of the main group, the affected mucosa was pale pink in color and had no pathological changes (Figure 3). In the control group, complaints and clinical manifestations disappeared later (on the 4-5th day) after the start of treatment.

When examining all 100% of patients of the main group with erosive-ulcerative lesions, already on the second day of treatment, the absence of pain in the damage zone and disappearance of bleeding during eating were noted. On the

3rd day of treatment the redness and signs of regeneration of erosive elements on the affected mucosa were revealed in all these patients, and on the 4th day the erosions were healed, signs of inflammation were completely absent, the oral mucosa had no pathological changes (Figure 4). At that time, in the control group complaints of pain while eating and talking were present for 3-4 days from the start of treatment, recovery was observed on the 5-7th day.

For an objective assessment of mucosal injury in chronic traumatic lesions, a cytological study was carried out, based on qualitative and quantitative characteristics of development stages of epithelial cells and cytopathological changes in the cell population. From the given data (Tables 1, 2) it can be seen that after the treatment young basal and parabasal cells completely disappeared and non-nucleated cells with a high degree of keratinization prevailed, that indicated the recovery of barrier function of the oral mucosa. Thus, after treatment of the main group of patients with chronic traumatic erythema, a significant ( $p < 0.001$ ) decrease in the specific weight of epithelial cells of intermediate transformation was revealed (from  $27.17 \pm 0.57\%$  to  $3.17 \pm 0.2\%$  – stage 3 and from  $27.9 \pm 0.4\%$  to  $10.47 \pm 0.32\%$  – stage 4) and a similar increase in cells of the late stage of differentiation (from  $8.09 \pm 0.33\%$  to  $53.17 \pm 0.5\%$ ), and as well as the cell differentiation index (from  $394.25 \pm 14.2\%$  to  $536.2 \pm 0.85\%$ ).

The main feature of cytological characteristics of impressions from the affected areas of oral mucosa with erosive-ulcerative lesions was the detection of single keratinized epithelial cells (respectively in  $3.0 \pm 0.21\%$  of patients with chronic traumatic erosion and in  $3.62 \pm 0.3\%$  of patients with decubitus ulcer,



**Figure 3.** Patient Z. Diagnosis: Chronic traumatic erythema of oral mucosa on the 3rd day of the treatment



**Figure 4.** Patient P. Diagnosis: Decubitus ulcer on the 7th day of the treatment

$p < 0.001$ ), which normally compose more than half of all cellular structures ( $53.1 \pm 0.49\%$ ).

Along with the criteria mentioned above, a significant ( $p < 0.001$ ) decrease in the cell differentiation index and pronounced microbial contamination of epithelial cells (Figure 5) on the background of increased total cellularity can be considered as a serious pathological process that needs active treatment.

The most significant changes in the parameters of cytological characteristics of the oral mucosa epithelium were revealed after course of therapy in patients of the main group with chronic traumatic erosion and decubitus ulcer. At the same time, all average statistical values of the percentage of squamous epithelial cells in the oral mucosa impressions, as well as the index of cell differentiation after treatment with a significance degree of 99-99.9% were differed from those before treatment. On the background of a decrease in total cellularity, signs of cell contamination by microorganisms disappeared. This indicated the high treatment efficiency of chronic mechanical injury of oral mucosa by PDT.

At the same time, assessment of the level of epithelial cell differentiation in the impressions of the oral mucosa in patients of the control group after traditional treatment did not reveal significant changes in parameters. In patients with chronic traumatic erosion of the control group, although young cells of the 1st and 2nd stages of maturity disappeared and the number of intermediate cells of type 1 decreased by half, compared to baseline ( $p < 0.01$ ), and the cell differentiation index significantly increased (from  $329.7 \pm 8.3\%$  to  $504.9 \pm 1.5\%$ ,  $p < 0.001$ ), but the average statistical values of type II intermediate cells and superficial cells with pyknotic nuclei and weakly basophilic cytoplasm did not change significantly (respectively,  $30.7 \pm 0.8\%$  against  $27.4 \pm 4.6\%$  and  $11.2 \pm 0.6$  against  $17.7 \pm 0.7\%$ ,  $p > 0.05$ ). It is obvious that the normalization of oral mucosa epithelization when using the traditional approach to the treatment of chronic traumatic erosion occurs more slowly than in the main group.

Examination of patients of the control group with decubitus ulcer revealed that in the cytograms of mucosa impressions there was a “shift to the left” in the balance of epithelial cells. Their significant number (stage 2 –  $2.67 \pm 0.7\%$ , stage 3 –  $13.14 \pm 0.6\%$ , stage 4 –  $17.7 \pm 1.14\%$ ) and microbial contamination indicated the low treatment efficiency of patients of the control group.

**Table I.** Results of cytological study in patients of the main group with chronic traumatic lesions of oral mucosa

Groups of examinees (number of patients)	Stages of differentiation of epithelial cells in the main group before treatment (%)						Stages of differentiation of epithelial cells in the main group after treatment (%)							
	1	2	3	4	5	6	IDC	1	2	3	4	5	6	IDC
Chronic traumatic erythema (n=17)		2.17 ± 0.33	27.17 ± 0.57	27.9 ± 0.4	34.8 ± 0.37	8.09 ± 0.33	394.25 ± 14.2		>0.05	3.17 ± 0.2	10.47 ± 0.32	33.17 ± 0.45	53.17 ± 0.5	536.2 ± 0.85
p										<0.001	<0.001	>0.05	<0.001	<0.001
Chronic traumatic erosion (n=9)	5.07 ± 0.63	33.7 ± 1.1	18.1 ± 0.63	29.7 ± 0.62	10.5 ± 0.68	2.8 ± 0.28	311.4 ± 9.5			3.5 ± 0.45	11.4 ± 0.8	33.5 ± 1.27	51.4 ± 0.95	532.8 ± 1.4
p										<0.001	<0.001	<0.001	<0.001	<0.001
Decubitus ulcer (n=6)	18.7 ± 1.38	27.1 ± 0.65	17.16 ± 0.65	25 ± 0.68	7.98 ± 0.39	3.3 ± 0.41	292.5 ± 16.9			3.8 ± 0.65	10.6 ± 1.07	32.6 ± 1.6	52.8 ± 0.5	533 ± 2.9
p										<0.001	<0.001	<0.001	<0.001	<0.001

Note: p - the significant difference in parameters in patients of the main group before and after treatment.

**Table II.** Results of cytological study in patients of the control group with chronic traumatic lesions of oral mucosa

Groups of examinees (number of patients)	Stages of differentiation of epithelial cells in the control group before treatment (%)						Stages of differentiation of epithelial cells in the control group after treatment (%)							
	1	2	3	4	5	6	IDC	1	2	3	4	5	6	IDC
Chronic traumatic erythema (n=18)		1.97 ± 0.31	27 ± 0.5	28.2 ± 0.38	34.5 ± 0.63	8.07 ± 0.5	536.2 ± 0.85			4.1 ± 0.3	12.6 ± 0.8	33.8 ± 0.7	50.01 ± 0.5	534.5 ± 4.05
p										<0.001	<0.001	>0.05	<0.001	>0.05
Chronic traumatic erosion (n=10)	4.93 ± 0.54	32.2 ± 1.23	18.1 ± 0.53	30.7 ± 0.8	11.2 ± 0.6	2.87 ± 0.2	329.7 ± 8.3			7.8 ± 0.5	27.4 ± 4.6	17.7 ± 0.7	47 ± 0.9	504.9 ± 1.5
p										<0.001	<0.001	>0.05	<0.001	<0.001
Decubitus ulcer (n=7)	18.13 ± 1.86	26.8 ± 1.14	18.4 ± 0.89	26.14 ± 0.68	8.2 ± 0.31	3.65 ± 0.33	289.5 ± 10.4			13.14 ± 0.6	17.7 ± 1.14	26.2 ± 1.25	43.2 ± 1.2	499.7 ± 8.85
p										<0.001	<0.001	>0.05	<0.001	<0.001

Note: p - the significant difference in parameters in patients of the main group before and after treatment.

## DISCUSSION

During the study, significant changes in cytological parameters were revealed in patients with erosive-ulcerative lesions of oral mucosa. The high treatment efficiency with PDT was indicated by a decrease in the total number of type I-II cells and a reduction their contamination by microorganisms, which is correlated with literature data on the wide antibacterial spectrum of the method. At the same time, no significant changes in clinical and cytological parameters were found in the control group after the treatment.

In patients with chronic traumatic erosion, despite the disappearance of young cells of the 1st and 2nd stages of differentiation and decreasing by half of the number of intermediate cells of type I, the average statistic parameter of intermediate cells of type II and superficial cells were not significantly changed. The patients with decubitus ulcer had a “shift to the left” in the balance of epithelial cells and microbial contamination, that indicated the low efficiency of traditional treatment [5].

Thus, the positive dynamics of cytological analysis parameters and the normalization of physiological condition of oral mucosa after the treatment of patients of the main group prove the high efficiency of chronic mechanical injuries treatment by the method of PDT using methylene blue in comparison with traditional treatment.

## CONCLUSIONS

1. The use of PDT for treatment of traumatic oral mucosa lesions contributed to the elimination of the main clinical manifestations of chronic mechanical injuries on the 3rd day of treatment in patients with chronic traumatic erythema and on the 5th-7th day in patients with erosive-ulcerative lesions, in contrast to the control group, in which the main clinical manifestations disappeared on 4-5 days in patients with traumatic erythema, and on 7-10 days in patients with erosive-ulcerative lesions.
2. The identified significant changes in the parameters of cytological characteristics of epithelial cells and the reduction of their contamination by microorganisms in patients with erosive-ulcerative lesions indicated the high efficiency of PDT usage in the treatment of traumatic injuries.

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# The Use of the Domestic Enzyme Preparation Pancreatin 8000 in the Rehabilitation of Patients with Chronic Pancreatitis After Surgery

## Wykorzystanie przygotowanego w warunkach domowych preparatu enzymatycznego Pankreatyna 8000 w rehabilitacji pacjentów z przewlekłym zapaleniem trzustki po zabiegu chirurgicznym

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### SUMMARY

**Aim:** To investigate the clinical efficacy of the domestic enzyme drug Pancreatin 8000 in the rehabilitation of patients with chronic pancreatitis after operations on the pancreas.

**Materials and Methods:** A study of 32 patients with chronic pancreatitis who received the drug Pancreatin 8000 (8000 lipolytic Ph. U., 5800 amylolytic Ph. U. and 380 proteolytic Ph. U.) The course of treatment was 21 days. In the course of the study we evaluated the growth rate index (calculated by the formula:  $B/P - 100$ , where B is weight in kilograms, P is growth in centimeters) and data of clinical examinations. A pain syndrome was estimated by the nature, expressed and depending on a meal and daypart.

**Results:** In average, normalization of the frequency of vomiting was noted on the 2nd-8th day, on the 8th day, vomiting in all the patients was once a day and formalized. Pain decreased and disappeared in the period from the 2nd to the 7th day. In 3 (7%) patients the pain did not decrease, that is why it was necessary to use pain-relieving drugs. The dynamics of body weight increase was from 1 to 4 kg during 3 months of taking the drug in different patients. No increase in body weight was noted in 1 (2%) patients. The disappearance of symptoms of gastrointestinal and intestinal dyspepsia was noted on the 2nd to 6th day.

**Conclusions:** Thus, the positive clinical effect of the drug Pancreatin 8000 is not only the result of the substituted enzyme therapy, but also the transition of the pancreas into a mode of functional calmness.

**Key words:** patients with chronic obstructive pancreatitis, Pancreatin 8000 enzymotherapy, dyspeptic syndrome, steatorrhea, postoperative rehabilitation

**Słowa kluczowe:** pacjenci z przewlekłym zapaleniem trzustki, enzymoterapia preparatem Pankreatyna 8000, zespół dyspeptyczny, stolce tłuszczowe, rehabilitacja pooperacyjna

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### INTRODUCTION

Growth disease incidence Chronic pancreatitis (CP), ineffectiveness of therapy that is carried out, which often occurs, the development of important complications are the reasons for the pivotal attention of clinicians to this pathology [1].

Methods of surgical treatment currently used for pancreaticoduodenal zone diseases are often of palliative nature and do not always lead to restoration of adequate functioning of the intestinal and gastrointestinal tract, to restoration of quality of life of the patients [2].

The main clinical symptoms of chronic pancreatitis are, first of all, pain syndrome, disorders of trauma associated with

external secretory deficiency of the pancreatic gland (PG), disruption of the function of the insular apparatus, biliary deficiency syndrome.

Not all cases (CP) can be treated surgically. In 70% of patients it is possible to achieve the least time-consuming treatment, which does not affect the quality of life of the patient. This is achieved through conservative treatment. When the arsenal of conservative treatment approaches is exhausted and no effect is achieved, surgical treatment is considered [3, 4]. In the last years most surgeons give preference to various organ-sparing surgeries [5]. In this case, the problem of preserving the duodenum (D) as the most important

sensory, regulatory and endocrine zone in surgical treatment of chronic pancreatitis is the most important [6].

Exosecretory function of the pancreatic gland plays a key role in the maintenance of intestinal traumatization as the main component of the traumatic pathway due to the unique multisubstrate set of hydrolytic enzymes in the pancreatic secretion.

Therefore, in case of secretory pancreas deficiency, a substitute enzymotherapy is indicated. It corrects and replenishes the lack of intestinal digestion and the resulting lack of absorption of primary micronutrients from the small intestine, leading to an authentic transformation of intestinal microflora. Regulatory properties of pancreatic enzymes are essential in their use not only to replace the lack of digestion but also to put pancreas into a reduced secretory activity mode, especially on an empty stomach [7, 8].

## AIM

Taking into account the current state of the problem of chronic pancreatitis treatment the development of pathogenetic substantiation of enzyme therapy schemes in patients with surgical diseases of pancreas during the period of postoperative rehabilitations was developed.

## MATERIALS AND METHODS

We studied 32 patients with chronic complicated pancreatitis who received Pancreatin 8000 (8000 lpolytic Ph. U., 5800 amylolytic Ph. U. and 380 proteolytic Ph. U.) The treatment course was 21 days. In the course of the study we evaluated the growth rate index (calculated by the formula:  $B/P - 100$ , where B is weight in kilograms, P is growth in centimeters) and data of clinical examinations. Pain syndrome was evaluated according to its character and severity, depending on the period and time of the day.

Pancreatin 8000 has an acid-proof membrane that protects enzymes from inactivation by the gastric juice, which makes it possible to use Pancreatin 8000 without combining it with drugs that reduce the action of hydrochloric acid [8].

Only under the influence of neutral or mildly acidic medium of the small intestine the coating is liquefied and enzymes are eliminated. Maximum enzymatic activity of the drug is detected 30-45 days after oral administration. Characteristics of this group of patients are given in Table 1.

The operations are carried out using modern technologies.

## RESULTS

In the course of the study we evaluated the growth-vaginal index (calculated by the formula:  $B/P - 100$ , where B is weight

in kilograms, P is growth in centimeters) and data of clinical examinations.

Pain syndrome was evaluated according to its character and severity, depending on the food and the time of day. The number and type of pain medications taken by the patients and their efficacy were noted. Dyspepsia syndrome was assessed by The following symptoms: heavy epigastric pressure after eating, nausea, vomiting, abdominal deflating, flatulence. In patients with chronic pancreatitis who have developed cysts After minimally invasive surgical intervention (external drainage of the bone under ultrasound control) the number and quality of the species were assessed. Frequency, quantity, character of feces at the stages of enzymocorrection were assessed, the quantity of neutral fat in feces was determined by microscopy.

In all patients with complicated chronic pancreatitis the degree of external secretory deficiency of pancreas was assessed as important: All the patients had marked pain after meals, heaviness in the region of the stomach, nausea, flatulence, poor feces from 3 to 6 times a day, the growth-volume index was 0.75-0.82. The acidic coating of the tablets protects the enzymes from inactivation by the gastric juice. Only under the influence of neutral or mildly acidic medium of the small intestine the coating is liquefied and the enzymes are eliminated. Maximum enzymatic activity of the drug is recognized 30-45 days after oral administration.

According to ultrasound investigation, all patients had signs of diffuse changes of pancreas, manifested to some extent or other, increased size of the gland, its increased echogenicity on ultrasound examination. The efficacy of Pancreatin 8000 in patients with pancreatic cysts after external drainage allows recommending it also in the postoperative period for adequate preparation of patients for the next stages of surgical treatment. We used Pancreatin 8000 orally 1 capsule 3 times a day during meals.

In average, the normalization of the rhythm frequency was noted on the 2nd-8th day, on the 8th day, the rhythm in all the patients was once a day and formed. The pain decreased and disappeared in the period from day 2 to 7. In 3 (7%) patients the pain did not decrease, that is why it was necessary to use pain-relieving drugs. The dynamics of body weight increase was from 1 to 4 kg during 3 months of taking the drug in different patients. In 1 (2%) of the patients

No increase in body weight was noted. Symptoms of gastric and intestinal dyspepsia disappeared on the 2nd to 6th day.

**Table 1.** Characteristics of the examined patients

Groups of patients studied	Age of patients (years)	Examination of the patients
Chronic pancreatitis with exocrine insufficiency	32 to 54	15
Ultrasonic drainage of pancreatic cysts glands	22 to 61	13
Pylorusparing pancreaticoduodenal resection	36 to 41	1
Medial resection of the body pancreas	35 to 52	2
Resection of the head of the pancreas with preservation of the duodenum		1
Total:		32

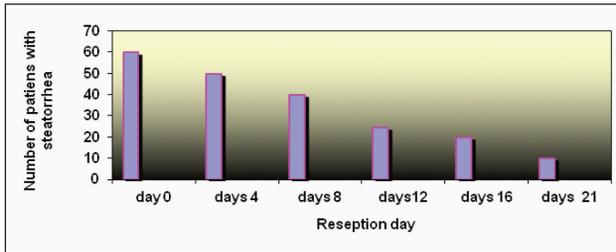


Figure 1. The results of the coprological examination

After normalization of these indices, the dose was gradually reduced: to 5-11 days – 2 capsules per day, to 15-18 days – 1 capsule per day. In the meantime, Pancreatin 8000 was used only when necessary. No reversion of clinical manifestations of external insufficiency was noted. The results of the coprological examination are shown in the Figure 1.

Dynamics of changes in the amount of neutral fat in the feces, assessed by coprological examination, and the efficiency of steatoreosis reduction in patients with chronic pancreatitis on the background of receiving Pancreatin 8000.

In all chronic pancreatitis patients the degree of steatorrhea was assessed as important (3 units). By the 21st day of treatment with Pancreatin 8000 the steatorrhea completely disappeared.

Taking into account the results obtained, it can be argued that the clinical effects of the course intake of Pancreatin 8000 are due to the fact that Pancreatin 8000 contains physiological doses of enzymes. Acidic coating of the tablets protects the enzymes from inactivation by the gastric juice. Only under the influence of neutral or mildly acidic medium of the small intestine, the coating is liquefied and the enzymes are eliminated. Maximum enzymatic activity of the drug is recognized 30- 45 days after oral administration.

We dynamically monitored patients who underwent surgeries on the pancreas and perampullary zone from the beginning of their food intake, and in patients chronic pancreatitis complicated by cysts, after external drainage under ultrasound control, biochemical and cytological examination of the intracellular contents on drains, i.e. after establishment of the nature of the secretion.

The comparative characteristics of the clinical effects of Pancreatin 8000 course treatment in patients who underwent different types of surgical interventions on the pancreatoduodenal area are presented in Table 2.

As we can see from Table 2, the effectiveness of the enzymotherapy depends on the volume of the surgical intervention on the pancreas. Pain syndrome decreased for the shortest period in patients who underwent cyst drainage under ultrasound control and resection of the pancreas head with preservation of the duodenum.

Pain syndrome persisted for a long time in patients after pylorus-preserving pancreatoduodenal resection (PPPDR). The frequency of stylostomy was normalized in short terms in patients after cyst drainage. Symptoms of gastric dyspepsia when receiving Pancreatin 8000 at the shortest possible time were cured in patients after medial resection of the pancreas body (MRPB), intestinal dyspepsia – in patients who underwent bone drainage under ultrasound control.

The number of drainage effluents from the pancreas ranged from 70 ml to 300 ml. In 85% of the patients, the amount of the fluid decreased by half to 11-17 days. During the follow-up period the amount of liquid in the drains tended to decrease only in 12% of the patients (Figure 2).

The time frame for decreasing the dose of the drug varied. Thus, the highest number of 3 capsules per day was taken by patients who had experienced (PPPDR). The above results of the study allow us to conclude that the substituted and corrosive therapy of external secretory deficiency of pancreas after surgical treatment with the enzyme preparation Pancreatin 8000 leads to the restoration of adequate functioning of the pancreaticoduodenal apparatus.

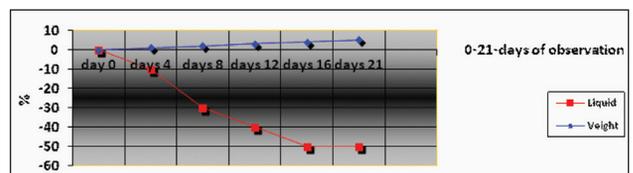


Figure 2. Clinical effects of using Pancreatin 8000

Table 2. Clinical effects of tertiary treatment with Pancreatin 8000 in chronic pancreatitis patients in the postoperative period

Types of operatios, parameters	Drainage of the crusts under ultrasonic control	Resection of the body of the pancreas	PSPDR	Resection of the head of the TZ with preservation DFS
Increase in weight tela	1,5-4,5 kg	2,1-3,2 kg	3,2 kg	1-3 kg
Buying pain syndrome	2-5 days	4-6 days	3-7 days	4-6 days
Buying Gastric dyspepsia	2-6 days	2-4 days	3-4 days	2-4 days
Copied from intestinal dyspepsia	2-4 days	4-5 days	5-7 days	4-6 days
Change doses up to 2 capsules per dey	6-9 days	8-10 days	9-12 days	7-8 days
Dose reduction to 1 capsules in dey	13-15 days	15-18 days	17-20 days	16-17 days

## DISCUSSION

Taking into account the current state of the problem in the treatment of patients with chronic pancreatitis, the work is aimed at the development of pathogenetic treatment regimens for patients with surgical diseases of the pancreas during the period of postoperative rehabilitation [1, 3].

The main goal of substitution therapy with pancreatic enzymes is to ensure sufficient ligase activity in the duodenum. It is known that the influence of hydrochloric acid on pancreatic enzymes leads to destruction of up to 90% of their quantity, that is why the way to undermine the gastric acid barrier was the creation of galenic forms of polyfermental preparations in the acid-stable lining [6, 8].

The use of the drug that has such a film increases fat absorption by 20% on average compared to a comparable dose of pancreatin without the film [4, 5]. Indications for substituted enzyme therapy in chronic pancreatitis with external hypersecretory deficiencies [8]:

- Steatorrhea with a fecal loss of over 15 g of fat per day;
- Progressive trophologic deficiency;
- Stable diarrheal syndrome and dyspeptic complaints.

A fundamentally important aspect of enzymotherapy is that it inhibits the stimulating pancreatic secretion, which is expressed in the body of Pancreatin 8000. We consider it important that galvanizing the secretion of the gland, giving it "functional exosecretory rest" can contribute to regenerative processes in the damaged organ.

Positive clinical effect of using Pancreatin 8000 is not only the result of substitutive enzymotherapy, but also the result of putting the pancreas into its secretory minimization mode, supported by Pancreatin enzymes galumphant 8000 with duodenum. This complex mechanism should explain the efficacy of the treatment of Pancreatin 8000 in patients with a complicated course of chronic pancreatitis. The dosage of Pancreatin 8000 must be administered on an individual basis.

In a number of cases in important patients, it is reasonable to increase the dosage of Pancreatin 8000 to 5-10 capsules per day. The efficacy of Pancreatin 8000 in patients with pancreas cysts after external drainage allows recommending it also in the preoperative period for adequate preparation of patients for further stages of surgical treatment.

## CONCLUSIONS

Thus, the positive clinical effect of using Pancreatin 8000 is the result not only of substitutive enzymotherapy, but also of putting the pancreas into a mode of functional calmness.

The efficacy of substitution therapy depends on the volume of surgical intervention on the pancreaticoduodenal complex. Dosage of Pancreatin 8000 must be administered on an individual basis.

In a number of cases in important patients, it is justified to increase the dosage of Pancreatin 8000 to 5-10 capsules per day.

The efficacy of Pancreatin 8000 in patients with pancreas cysts after external drainage allows recommending it in the preoperative period for adequate preparation of patients for further stages of surgical treatment.

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# Correction of Body Posture Disorders in Young Children of School Age in the Process of Physical Education Classes

## Korekcja zaburzeń postawy ciała u małych dzieci w wieku szkolnym w trakcie zajęć wychowania fizycznego

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### SUMMARY

**Aim:** To develop, substantiate and experimentally test the method of correction of body posture disorders in 6-10-years-old girls in the process of their coordination skills development.

**Materials and Methods:** The research involved 138 girls including 40 girls who had various deviations in body posture development and 98 girls without body posture disorders. The experimental (EG) and the control group (CG) of 20 girls each were formed to organize the experiment. The EG was engaged according to the developed method of correction of body posture disorders, the CG – according to the current school curricula of physical education.

**Results:** It was found that 29.0 % of primary high schoolers have various deviations in body posture development. Kyphotic body posture is observed in 80.6 % of cases and scoliotic body posture – in 19.4% of cases. The research determined the relationship between the level of coordination manifestation and the state of body posture in schoolers, in particular the presence of abnormalities in its development. The method of correction of body posture disorders in 6-10-years-old girls during physical education training sessions was developed.

**Conclusions:** The obtained results indicate the effectiveness of the developed method. The EG girls revealed significantly better indicators of motion coordination and coordination skills when changing body position as well as static balance than the CG girls ( $p \leq 0.05$ ). The number of girls with various deviations in body posture development decreased by 9.9%.

**Key words:** body posture disorders, coordination skills, 6-10-years-old girls, physical education, correction

**Słowa kluczowe:** zaburzenia postawy ciała, koordynacja ruchowa, dziewczynki w wieku 6-10 lat, wychowanie fizyczne, korekcja

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### INTRODUCTION

The analysis of current statistics shows that the number of children with chronic diseases increases 2.5 times during school life: about a third of primary high schoolers already have various health disorders, while only up to 20% of school leavers remain virtually healthy [1, 2]. Deviations in the development of body posture occupy one of the leading places in the structure of morbidity of school-age children, moreover having recorded positive dynamics with age [3, 4]. Body posture disorders, in addition to a significant cosmetic defect, create the preconditions

for the general deterioration of health, reduced physical development, the emergence of pathological processes in the body of schoolers [5, 6].

The primary school age is characterised by active formation of the musculoskeletal system of children, which increases the risk of disorders in the formation of physiological curves of the spine under the influence of anatomical and physiological factors: hereditary constitutional features, individual development of motor function and irrationally organized motor activity [7, 8]. At the same time, according to the scientists [9, 10], the vast majority of

cases of body posture disorders in primary high schoolers have an unstable functional nature i.e. can successfully be corrected.

The researchers [11, 12], argue that the constant use of precisely dosed tensions of the muscular corset on the basis of learning different in terms of coordination structure and direction motions develops skills to maintain physiologically correct torso positions in static and dynamic positions. At the same time, 6-10-years-old children actively develop motor function, in particular most types of coordination skills, the ability to coordinate motions and control them [13]. Along with sufficient elaboration of the problem of children's body posture formation, prevention and correction of its disorders by means of physical exercises, there is not enough research in modern theory and practice devoted to the peculiarities of motor function development in primary high schoolers with deviations in body posture development. The question of correction of body posture disorders in the process of coordination skills development in 6-10-years-old girls remains open, which requires scientific research.

### AIM

The aim of the research is to develop, substantiate and experimentally test the method of correction of body posture disorders in 6-10-years-old girls in the process of their coordination skills development.

### MATERIALS AND METHODS

Scientific research methods included theoretical analysis of literature sources, medical and biological methods, pedagogical testing, pedagogical experiment, statistical methods.

The theoretical analysis of literature sources involved the study of 17 literature sources from different scientometric databases, which allowed to comprehensively investigate the problem on the research topic and discuss the results in comparison with the conclusions of scientists in this field. The medical and biological methods included somatometry and somatoscopy: determination of the body type of children; determination of the type of children's body posture disorders using the method of indices: scoliotic body posture by the index of vertical curvature of the spine, kyphotic body posture (stooping) by the shoulder index. We used pedagogical testing to check the level of manifestation of coordination skills of junior high schoolers, in particular static and dynamic balance of the body, coordination of motions and coordination skills when changing body position. The static balance of the body was determined using the modified Romberg test [14]. The ability to maintain balance was assessed as follows: holding the position of "attention" for less than 15 seconds – grade "1"; holding the position of "attention" for 15 seconds – grade "2"; raise your hands forward, stand for another 15 seconds – grade "3"; close your eyes (or lower the bandage) and stand for another 15 seconds – grade "4"; raise your head with your eyes closed and stand for another 15 seconds – grade "5". Yarotsky's test was used to determine

the dynamic balance [14]. The exercise was performed from the standing preparatory position with eyes closed, while the persons under investigation began to continuously turn their heads in one direction at a rate of two motions per second at the word of command. The time was recorded with an accuracy of 0.1 seconds from the beginning of the rotation to the loss of balance. "Ten Eights" test was used to determine the level of motion coordination [14]. This coordination test provided for the performance of ten cycles of hand motions by the high schooler with a tennis ball in the shape of "eight" between the legs from the angle position in the legs straddled position, passing the ball from one hand to another. Coordination skills when changing the position of students' bodies were determined using the test developed by us. The high schoolers under examination were asked to perform a sequence of motions in 10 seconds: 1 – squat rest position; 2 – front plank; 3 – squat rest position; 4 – location normal standing position. The eventual result of the test is to record the number of complete cycles and partial performance of the exercise in 10 seconds. The assessment of partial performance was as follows:  $\frac{1}{4}$  – performance of motion on the count of 1;  $\frac{1}{2}$  – performance of motion on the count of 2;  $\frac{3}{4}$  – performance of motion on the count of 3. The integrated indicator of coordination skills of junior high schoolers with deviations in body posture development was evaluated by the index of coordination skills, which is calculated as the difference in the speed of 3x10m shuttle running and 30m running.

The pedagogical experiment lasted 1 year and was conducted in order to substantiate the content of the method of correction of body posture disorders in the development of coordination skills of 6-10-years-old girls during physical education training sessions and test its effectiveness. The research involved 138 girls studying in 1-4 forms of secondary schools in Kyiv, including 40 girls with various deviations in body posture development and 98 girls without body posture disorders. The experimental (EG) and the control group (CG) of 20 girls each were formed to organize the pedagogical experiment. There was no special selection, the homogeneity of the groups was confirmed by the absence of a significant difference between all the studied indicators at the beginning of the experiment ( $p > 0.05$ ). The EG was engaged according to the developed method of correction of body posture disorders of 6-10-years-old girls in the process of developing their coordination skills, the CG – according to the current school curricula of physical education.

The methods of statistical data processing include the method of sampling and the pair correlation of Pearson, the Student's criterion for quantitative and qualitative processing of research results, determining their reliability.

The procedure for organizing the research was previously agreed with the Committee on compliance with Academic Integrity and Ethics of the National Pedagogical Drahomanov University. Prior consent to participate in the research was obtained from all the participants.

## RESULTS

In the process of studying the peculiarities of physical development of modern high schoolers, it is important to assess the type of their body build, as the development of bone and muscle components of the body may be a prerequisite for various abnormalities in the development of children's body posture. Somatometry showed that primary high schoolers are presented by 39.9% of girls with asthenoid somatotype, 30.3% of female high schoolers having thoracic body type, 21.3% of girls being characterized by muscular type of body build and 8.5% of schoolgirls with digestive somatotype. The obtained results were confirmed by visual assessment of the body build.

According to the index method, it was found that 29.0% among the general contingent of 6-10-years-old girls is characterised by various deviations in body posture development. At the same time, the majority of girls with body posture disorders (92.7%) have an asthenoid somatotype. Herewith, 80.6% of cases are characterised by stooping (kyphotic body posture) and the remaining 19.4% of cases – by scoliotic body posture in different variants of vertical curvature of the spine.

The pedagogical testing showed that the static balance indicator of 6-8-years-old female high schoolers who do not have body posture disorders is  $3.1 \pm 1.1$  points, the peers with body posture disorders –  $2.1 \pm 0.8$  points and this indicator makes  $3.1 \pm 0.9$  points and  $2.1 \pm 0.8$  points, respectively, in 9-10-year-old female high schoolers. The indicator of dynamic balance in healthy girls is  $27.4 \pm 7.3$  seconds in the age of 6-8 years and  $28.4 \pm 10.9$  seconds in the age of 9-10 years; the female high schoolers with deviations in body posture development are characterised by  $19.2 \pm 3.8$  seconds in the age of 6-8 years and by  $19.8 \pm 5.4$  seconds in the age of 9-10 years. The indicator of motion coordination in healthy female high schoolers is  $18.1 \pm 1.6$  seconds in the age of 6-8 years and  $15.2 \pm 1.5$  seconds in the age of 9-10 years, and it makes  $21.5 \pm 2.3$  seconds and  $18.5 \pm 1.9$  seconds, respectively, in 6-8-years-old and 9-10-years-old girls with body posture disorders. The indicator of the sample, which measures the level of coordination skills when changing body position in space, in healthy 6-8-years-old female high schoolers and 9-10-years-old girls is  $6.2 \pm 0.5$  times and  $7.3 \pm 0.5$  times, respectively, while in the peer indicators with body posture disorders are  $5.6 \pm 0.4$  times and  $6.4 \pm 0.4$  times, respectively. The index of

coordination skills in 6-8-years-old girls and 9-10-years-old ones without signs of body posture disorders is  $4.0 \pm 0.2$  seconds and  $3.9 \pm 0.2$  seconds, respectively, and it makes  $4.4 \pm 0.3$  seconds and  $4.3 \pm 0.2$  seconds, respectively, in 6-8-years-old female high schoolers with body posture disorders. Thus, it was found that the indicators of coordination skills are significantly ( $p \leq 0.05$ ) better in healthy 6-10-years-old children than in their peers who have deviations in body posture development.

The correlation analysis was used to determine the relationship between the level of manifestation of coordination skills of primary female high schoolers and the state of their body posture i.e. scoliotic or kyphotic (Table 1).

Correlations of moderate strength between the indicator of static balance and scoliotic body posture ( $r \leq 0.35$ , at  $p \leq 0.05$ ), the indicator of dynamic balance and scoliotic body posture ( $r \leq 0.31$ , at  $p \leq 0.05$ ), the indicator of motion coordination and scoliotic body posture ( $r = 0.33$ , at  $p \leq 0.05$ ) were established. Correlations of moderate strength between the indicator of dynamic balance and kyphotic body posture ( $r \leq 0.28$ , at  $p \leq 0.05$ ), the indicator of motion coordination and kyphotic body posture (stooping) ( $r = 0.45$ , at  $p \leq 0.05$ ), the indicator of coordination skills when changing body position and kyphotic body posture ( $r \leq 0.40$ , at  $p \leq 0.05$ ) were also recorded. The relationship between the level of development of motor coordination in 6-10-years-old girls formed the basis of the method of correction of posture disorders in 6-10-years-old girls in the process of developing their coordination skills during physical education training sessions.

The main purpose of the developed method is to emphasize the impact on the vestibular, motor and visual analysers through a system of exercises aimed at controlling motions in space under conditions of static positions and during movement. The content of the method was based on the principle of combined action on motion coordination and correction of muscle asymmetry, which consists in the variable application of physical activity associated with the reproduction of spatial, rhythmic, dynamic, plastic characteristics of static body postures or motions. Differentiation of the content of physical activity was ensured by taking into account the type of body posture disorder in girls, in particular the characteristic features of the asymmetry of the spine and informative types of coordination skills. The selection of coordination exercises

**Table 1.** Relationship between the level of manifestation of coordination skills with posture disorders in 6-10-years-old girls

Indicators of coordination skills	Index of vertical curvature of the spine (scoliotic body posture)	Shoulder index (kyphotic body posture)
Static balance	-0.35*	-0.28*
Dynamic balance	-0.31*	-0.20
Motion coordination	0.33*	0.45*
Spatial coordination	-0.17	-0.40*

Note: \* – a reliable relationship between the studied indicators at  $p \leq 0.05$

**Table 2.** Dynamics of coordination skills development in the EG and the CG girls in the course of the experiment (Mean±SD)

Researched indices	Groups	Stages of the experiment		Increase in the indicator,%	Significance of the difference
		Beginning	End		
6-8-years-old girls (EG: n=11, CG: n=10)					
Static balance, points	CG	2.1±0.8	2.5±0.7	17.4	p>0.05
	EG	2.2±0.9	4.3±0.9	64.6	p≤0.05
Dynamic balance, seconds	CG	19.2±1.8	19.7±1.3	2.6	p>0.05
	EG	19.0±1.3	19.8±1.6	4.1	p>0.05
Coordination skills when changing body position, number of times	CG	5.6±0.4	5.8±0.2	25.7	p>0.05
	EG	5.5±0.3	7.0±0.7	24.0	p≤0.05
Motion coordination, seconds	CG	21.5±0.3	21.9±0.4	1.8	p>0.05
	EG	21.3±0.5	23.9±1.2	11.5	p>0.05
Index of coordination skills, seconds	CG	4.56±0.1	4.33±0.2	5.2	p>0.05
	EG	4.59±0.2	4.11±0.1	11.0	p≤0.05
9-10-years-old girls (EG: n=9, CG: n=10)					
Static balance, points	CG	2.1±0.8	2.7±0.6	25	p>0.05
	EG	2.0±0.9	4.0±0.8	66.7	p≤0.05
Dynamic balance, seconds	CG	19.8±1.4	20.2±1.1	2.0	p>0.05
	EG	19.9±1.2	20.3±0.9	1.9	p>0.05
Coordination skills when changing body position, number of times	CG	6.4±0.4	6.6±0.6	3.1	p>0.05
	EG	6.6±0.5	8.2±0.9	21.6	p≤0.05
Motion coordination, seconds	CG	18.5±0.9	19.0±0.7	2.7	p≤0.05
	EG	18.3±0.8	20.2±0.9	9.8	p≤0.05
Index of coordination skills, seconds	CG	4.29±0.2	4.01±0.2	6.8	p>0.05
	EG	4.31±0.3	3.78±0.2	13.1	p≤0.05

for children with body posture disorders took into account the sensitive phases of development of certain types of coordination skills of children of different types of somatic constitution, followed the methodological peculiarities of coordination skills development, focused on learning proper breathing during exercise. In order to increase the health orientation of physical education training sessions, organizational and pedagogical conditions for the effective development of coordination skills in primary high schoolers with posture disorders were determined, in particular: elimination of causes that stipulate the occurrence of functional disorders of high schoolers' body posture; stable motivation, need and habit for a healthy lifestyle and exercise; creating a healthy school environment and cooperation with parents; systematic medical and pedagogical control over the dynamics of children's body posture; combined development of motor skills with measures to correct body posture and prevent its disorders; providing feedback based on the assessment of high schoolers' academic achievements during physical education classes.

Considering the fact that the majority of indicators of motion coordination and body proportions of primary female high schoolers do not differ significantly, age differentiation took into account the most informative indicators of coordination skills of 6-10-years-old female high schoolers who have scoliotic or kyphotic body posture. Thus, the content of the method of developing coordination

skills of girls with scoliotic body posture included exercises to develop static and dynamic balance, coordination of motions, whereas girls with kyphotic body posture – exercises to develop static balance, motion coordination and spatial orientation.

We used constant variation of exercises in the process of developing the coordination skills of children of primary school age with posture disorders. First, it helps to learn new forms of motions, and secondly, to improve motor memory, the stereotype of correct body position, motor sensations. Particular attention in the development of coordination skills of students with body posture disorders was paid to learning proper breathing: lifting the chest envisages intake of breath, lowering – outward breath, during muscle tightness – intake of breath, during relaxation – outward breath.

When planning motor tasks of coordination orientation for junior high schoolers with body posture disorders, the possibility of regulating such components of physical activity as complexity, intensity, duration of the exercise and the number of repetitions, duration of rest pauses between individual exercises and its nature were taken into account. A wide range of coordination difficulties was used to develop coordination skills: 30-60% of the individually accessible level for optimal stimulation of sensory analyzers, activation of the development of adaptive reactions of the neuromuscular system to new forms of motions and body positions.

The intensity of exercises at the initial stage of implementation of the method was relatively low. Gradual increase in the intensity of motor tasks occurred with the formation of mechanisms of adaptation and growth of functional capabilities of the musculoskeletal and vestibular sensory systems of the body. The duration of a particular motor task or a set depended on the task: we used exercises lasting from 1-5 seconds to 180 seconds depending on the coordination complexity and intensity of the motor task to ensure proper muscle regulation and quality exercise prior to fatigue or reduction of children's attention.

The developed method was used in the first half of the main part of the training session in the form of sets of coordination exercises and partly in the preparatory part during drill practice and general developmental exercises in motion and stationary exercises. Under such conditions, sets of coordination exercises with high schoolers having posture disorders should be performed in rooms with mirrors, as body posture formation is based on musculoskeletal sensation, and mirrors allow the high schoolers to visually control the correct body position in the process of body posture holding and in motion. Since coordination skills are developed during the learning of new motions in different sections of the curriculum in physical education for high schoolers of 1-4 forms, and when using exercises to develop other physical qualities (strength, speed, flexibility, endurance), then the impact on improving coordination of motions, beyond the method, took place in parallel throughout the physical education training session. Inasmuch as rhythmic, strength and spatial images of motions are perceived by primary high schoolers first and foremost in feelings, imagination and generalized impressions, than learning new motions and forming their dynamic stereotype using a holistic method of learning at this age is more successful than learning in parts.

The results obtained in the process of pedagogical experiment indicate the effectiveness of the proposed method (Table 2).

In addition, it was found that the number of girls with various deviations in body posture development decreased by 9.9% on average (from 29.0% to 19.1%). At the same time, the number of girls with stooping (kyphotic body posture) decreased by 6.4% and the number of girls with scoliotic body posture in different variants of vertical curvature of the spine decreased by 3.5%.

## DISCUSSION

The theoretical analysis of the literature [5, 6, 13, 15, 16] has shown that one of the main means of body posture correction is exercise, which has a stabilizing effect on the spine, improves respiratory function and strengthens the muscles of the torso. Herewith, since the formation of the correct motor stereotype of body posture depends on muscle tone and coordination of symmetrical muscles of the torso, muscles that support physiological curves of the spine, so the development of coordination of motions of primary high schoolers is a necessary condition for consolidating

physiologically correct torso positions while maintaining a stable body position and performing movements.

The primary school age (6-10 years old) is characterised by active anatomical and physiological changes in the body of children, the course of which is smooth in nature without significant gender differences. It is instantiated by complex morphofunctional and mental changes: high growth rates, weight gain, intense changes in both the structure and functions of individual organs and systems of the body. The scientists [1-4] found that the main cause of functional disorders of body posture in primary high schoolers is limited motion, i.e. prolonged forced static position and simultaneously low physical activity during learning activities, which coincides with the period of active development of the child's body.

It is determined that the performance of any motion, keeping body posture or movement of the body and its parts in space is due to the motor function of a human being. At the same time, motor dysfunction is functionally dependent on the state of health [7, 10, 17]. It was found that the degree of development and ability to improve the motor sphere of children is limited by the presence of disorders of sensory and physiological systems of the body, including disorders of the musculoskeletal system, which include abnormalities in body posture. Since the age of 6-10 years is favourable for the development of most motor skills and is an active period in the development of motor function, so deviations in the development of body posture at this age are unstable and successfully subject to pedagogical influence. In our work we have studied the physical condition of 6-10-years-old girls, which provides for their biological needs in motion and the development of coordination skills in the most favourable age. It is established that the primary school age is a period of active development of various types of coordination skills. Thus available means for primary high schoolers' development are form building exercises of dynamic character with and without objects, at the same time covering the basic groups of muscles, exercises in balance, dance exercises, acrobatic exercises, elements of martial arts, mobile and sports games, movement with obstacles, related to mastering the correct technique of natural motions: jumping, running, climbing, throwing. Based on the research, we have substantiated and developed the method of correcting body posture disorders in 6-10-years-old girls in the process of developing coordination skills during physical education training sessions. Proper dosing of coordination loads contributes to the health effect of exercises: improves motor coordination of children, corrects static and dynamic stereotypes of body posture, improves muscle tone, strengthens the muscular corset and stimulates a rational level of spinal mobility. Therefore, the sets of exercises in the training sessions were built taking into account the gradual increase of coordination complexity of motor tasks and increasing the intensity of motions. Coordination exercises were differentiated by: anatomical features (for specific muscle groups of the torso, lower and upper extremities); type of body posture disorder (scoliotic, kyphotic, the presence of signs

of both disorders); character (static, dynamic); orientation (on the coordination of motions, static, dynamic balance, spatial orientation, spatial-dynamic accuracy, arbitrary muscle relaxation, etc.); complexity of execution (simple and complex); method of application (repeated repetition of the same type of exercises, changes in conditions and methods of performance, game orientation). The results of the pedagogical experiment prove the effectiveness of our proposed method of correction of posture disorders in 6-10-years-old girls in the process of developing their coordination skills.

## CONCLUSIONS

1. It was found that 29.0% among the general contingent of primary female high schoolers is characterised by various deviations in body posture development. Herewith, 80.6% of cases are characterised by children stooping (kyphotic body posture) and the remaining 19.4% of cases – by scoliotic body posture in different variants of vertical curvature of the spine. It was found that the vast majority (92.7%) of female high schoolers with deviations in body posture development have an asthenoid body type. At the same time, the indicators of coordination skills are significantly higher in healthy 6-10-years-old children than in their peers who have deviations in body posture development (at  $p \leq 0.05$ ).
2. The research determined the relationship between the level of coordination manifestation and the state of body posture in junior high schoolers, in particular the presence of abnormalities in its development (scoliotic or kyphotic body posture). Thus, correlations of moderate strength between scoliotic body posture and the indicator of static balance ( $r \leq 0.35$ , at  $p \leq 0.05$ ), the indicator of vestibular tolerance (dynamic balance) ( $r \leq 0.31$ , at  $p \leq 0.05$ ), the indicator of motion coordination ( $r = 0.33$ , at  $p \leq 0.05$ ), correlations of moderate strength between kyphotic body posture (stooping) and the indicator of dynamic balance ( $r \leq 0.28$ , at  $p \leq 0.05$ ), the indicator of motion coordination ( $r = 0.45$ , at  $p \leq 0.05$ ), the indicator of coordination skills when changing body position and the presence of kyphotic body posture ( $r \leq 0.40$ , at  $p \leq 0.05$ ) were established in girls.
3. The method of correction of body posture disorders in 6-10-years-old girls in the process of their coordination skills development during physical education training sessions was developed. The purpose of the method is to emphasize the impact on the vestibular, motor and visual analysers through a system of exercises aimed at controlling motions in space under conditions of static positions and during movement.
4. The results of the pedagogical experiment indicate the effectiveness of the proposed method. The EG female high schoolers revealed significantly higher indicators of motion coordination, coordination skills when changing body position and static balance than the CG girls ( $p \leq 0.05$ ). There was a significant improvement in the indicators of general motion coordination in the EG girls at the end

of the experiment ( $p \leq 0.05$ ), in contrast to the CG female high schoolers, where the increase in the indicator is insignificant ( $p > 0.05$ ). Thus, this indicator in 7-8-years-old and 9-10-years-old female high schoolers improved by 10.4% seconds and 9.4% seconds, respectively. In addition, it was found that the number of primary female high schoolers with various deviations in body posture development decreased by 9.9%. At the same time, the number of girls with kyphotic body posture decreased by 6.4% and the number of girls with scoliotic body posture by 3.5%.

Prospects for further research are to test the effectiveness of the developed method for body posture correction in 11-12-years-old children.

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# Preventive Model of Formation of Health-save Competence of Student Youth with the Use of Natural Physiotherapy

## Profilaktyczny model kształtowania kompetencji prozdrowotnych młodzieży akademickiej z wykorzystaniem fizjoterapii naturalnej

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### SUMMARY

**Aim:** The aim of the study is to determine the basic conceptual, methodological and organizational-methodological aspects of the process of forming health competence of students using natural physiotherapy, to formalize them in the form of a preventive model.

**Materials and Methods:** The pedagogical experiment lasted during 2019-2021 in Sumy State Pedagogical University named after A.S. Makarenko. The pedagogical research was attended by 128 first- and second-year students majoring in «Physical Education», «Physical Therapy, Occupational Therapy» Sumy State Pedagogical University named after A.S. Makarenko. The research methods were as follows: analysis of special and scientific literature, pedagogical observation, pedagogical experiment, pedagogical testing, methods of statistical data processing.

**Results:** In order to organize and systematize this theoretical and practical experience, we have developed a preventive model of forming health-save competence of students, which allows to form an idea of the determinants of health, ways to strengthen it, guide students to follow the rules of healthy living and application of a wide range of natural physiotherapeutic means.

**Conclusions:** The pedagogical model of formation of health-save competence orients students on observance of rules and norms of a healthy way of life with application of natural physiotherapeutic means (physical exercises, water procedures, air, solar heat and light), systematizes and formalizes representations of integral, multilevel, integrative, interdisciplinary educational process in the conditions of educational institution.

**Key words:** determinants of health, health-save competence, natural physiotherapy, preventive model

**Słowa kluczowe:** determinanty zdrowia, kompetencje w zakresie ochrony zdrowia, fizjoterapia naturalna, model profilaktyki

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### INTRODUCTION

The state of health determines not only the general well-being of a person, but also directly affects the intellect, the psyche, and socio-political behavior, ie is the basis on which all the activity of the individual. However, the dominance of consumer standards in modern society imposes patterns of behavior that contradict the natural laws of life. As a result, success is often achieved at the cost of one's own health, and thus loses its value. One of the reasons for this is the lack of necessary knowledge about health or the inability or unwillingness to implement it in practice. This is especially true for young people.

In modern conditions of aggravation of economic, health, demographic problems, the state of health of children and student youth is of particular concern [1-6]. In the public consciousness, health is associated primarily with physical culture, motor activity. There are good reasons for this, because movement is a powerful factor in health [7]. At the same time, the phenomenon of human health is a multi-component hierarchical structure as a result of various factors, some of which go beyond the competence of physical education or medicine [8-10]. Successful solution of health problems requires a comprehensive approach, which is based on understanding the essence of individual health, knowledge

of the mechanisms of recovery, factors and processes that determine this condition [11]. From the point of view of pedagogical practice, human health as a part of the socio-natural system depends, first of all, on human behavior, way of life [12, 13], cultural traditions [14], general culture and health culture as its component [15].

Professional teaching of health science requires finding and applying new ways, means, forms of education. In the process of organizing educational activities, it is important to create favorable conditions for stimulating personal activity of students and optimizing practical activities based on the acquired knowledge. Health practice is an individual activity that involves mastering the concept of health, the formation of a healthy lifestyle, the development of creative health thinking, formation of values of health, a healthy way of life, so the formation of health-save competence of student youth is an important and urgent task in education [16].

### AIM

The aim of the study is to determine the basic conceptual, methodological and organizational-methodological aspects of the process of forming health competence of students using natural physiotherapy, to formalize them in the form of a preventive model.

### MATERIALS AND METHODS

The pedagogical experiment lasted during 2019-2021 in Sumy State Pedagogical University named after A.S. Makarenko. The pedagogical research was attended by 128 first- and second-year students majoring in «Physical Education», «Physical Therapy, Occupational Therapy» Sumy State Pedagogical University named after A.S. Makarenko. The assessment of the cardiovascular system was determined by measuring blood pressure and heart rate both at rest and during exercise (Rufier index). The condition of the respiratory system was assessed by the number of respiratory cycles per minute and the test with respiratory arrest after exhalation (Genchi test). The level of development of physical qualities was diagnosed by assessing the overall endurance (running 2 km), strength (pulling up on a horizontal bar or bending the arms off the floor for men; lifting the torso from a supine position, hands behind his head for women), and speed and strength qualities (long jump from a place). The level of immune protection was determined by the number of colds during the year by survey (questionnaire). The method of pedagogical modeling was used to build the model.

The research methods were as follows:

- analysis of special and scientific literature – to identify the relevance of the problem under study in Ukraine and in the world;
- pedagogical observation – to identify the strengths and weaknesses of the level of physical fitness of students;
- pedagogical experiment – to compare the results of the experimental groups and the proposal of a methodology to increase the level of physical fitness of students;
- pedagogical testing – to obtain reliable information about the levels of physical fitness in different periods of the experiment;

- methods of statistical data processing – for mathematical processing of the obtained research results.

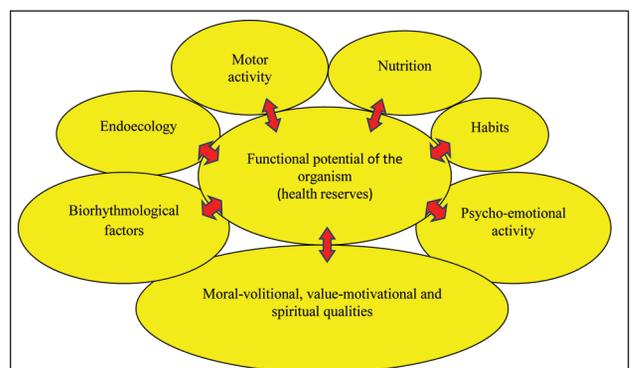
The Ethics Commission of the Sumy State Pedagogical University named after A.S. Makarenko has no comments on the methods used in this study.

### RESULTS

We consider the health-save competence of the student as an integral characteristic of the personality, the basis of which is knowledge about health, educational and life experience, a system of worldviews, beliefs, motives, values that determine the ability to successfully solve problems of forming, maintaining and strengthening health.

According to modern research, the distribution of individual lifestyle factors and some other reasons according to the degree of impact on morbidity and life expectancy is approximately as follows: nutrition – 25%, smoking – 25%, physical activity – 22%, excessive alcohol consumption – 10%, infectious diseases – 7%, exposure to toxic substances, unreasonable and excessive use of drugs – 6%, sexually transmitted diseases – 2.5%, road injuries – 1.5%, firearms – 1% [17]. However, these results leave room for debate, as they do not cover all of the most influential health factors. In particular, they do not take into account such components as the psycho-emotional aspect, the influence of which is increasingly receiving scientific confirmation [18–22], the ecological state of the internal environment (endoeology), biorhythmology and other factors, the presence or absence of which also affects man. Based on the analysis and generalization of modern scientific data, our own empirical experience, we have identified the main determinants that can both increase the reserves of individual health and decrease (Figure 1).

Of course, the variety of health factors is not limited to the determinants outlined. However, scientific data show that ignoring them is often the cause of various diseases. The results of our study allowed us to trace the relationship between the main indicators of the functioning of the cardiovascular and respiratory systems, the condition of the skin as a «mirror of health» (O. Zalmanov), the level of physical development and the number of colds during the year (Table 1). For example, students who have 8–9 respiratory cycles per minute at rest are able to hold their breath after



**Figure 1.** Determinants of the functional potential of the organism and reserves of individual health

**Table 1.** Relationship between cardiovascular and respiratory systems, skin condition, physical development and the number of colds during the year

<b>Breathing and blood circulation</b>							
Number of respiratory cycles in a state of rest for 1 minute	20-24	16-19	12-15	10-11	8-9	6-7	5
Breath delay time after middle exhale (sec)	21-30	31-40	41-50	51-60	61-90	91-110	111-130
Heart rate at rest, (bpm)	more than 90	80-90	75-79	68-74	59-67	60 or less	
Ruffier Index		15,1-20	10,1-15	5-10	0,1-5	0 and less	
BP at rest, mm Hg	more than 140/90 less than 80/50	131-140/ 81-90/ 80-89/ 50-54	90-99/ 50-59	121-130/ 76-80	111-120/ 71-75/ 100-105/ 76-80	106-110/ 60-70	
Vital indicator (vital capacity of the lungs by body weight, ml/kg):							
- men	less than 50	50-55	56-60	61-65	66-70	more than 70	
- women)	less than 40	40-45	46-50	51-55	56-60	more than 60	
<b>Skin</b>							
The condition of the skin, its appearance	Oily or dry flabby skin. Rash, pimples, acne. Unsatisfactory heat regulation. Unpleasant smell		Unhealthy earthy gray colour, peeling, wrinkles, bruises under the eyes		Normal skin type, pink color, no acne		Pure, beautiful, elastic, without any disadvantages and bad skin odors, good thermal regulation
<b>The support-motor apparatus and physical qualities</b>							
Total endurance							
Running 2 km, min, sec:							
- men	more than 12.00	11.01-12.00	10.01-11.00	9.01-10.00	8.01-9.00	7.30-8.00	less than 7.30
- women	more than 14.00	13.01-14.00	12.01-13.00	11.01-12.00	10.01-11.00	9.30-10.00	less than 9.30
Strength endurance							
Pull-ups on a horizontal bar or flexion and extension of the arms from the floor (men)	Less 2 times	2-3	4-6	7-10	11-14	15 and more	
Lifting the trunk from the position lying on the back, hands behind the head, legs fixed (women)	Less 4 times less than 10 times	4-9 10-19	10-19 20-29	20-29 30-39	30-39 40-49	40 and more 50 and more	
Speed-power qualities, agility. Jumps in length from place, (cm):							
- men	less than 200	200-205	206-210	211-215	216-220	221 and more	
- women	less than 140	140-145	146-150	151-155	156-160	161 and more	
Level of immune protection							
Number of colds during the year	more than 5	4-5	3	2	1	not sick	

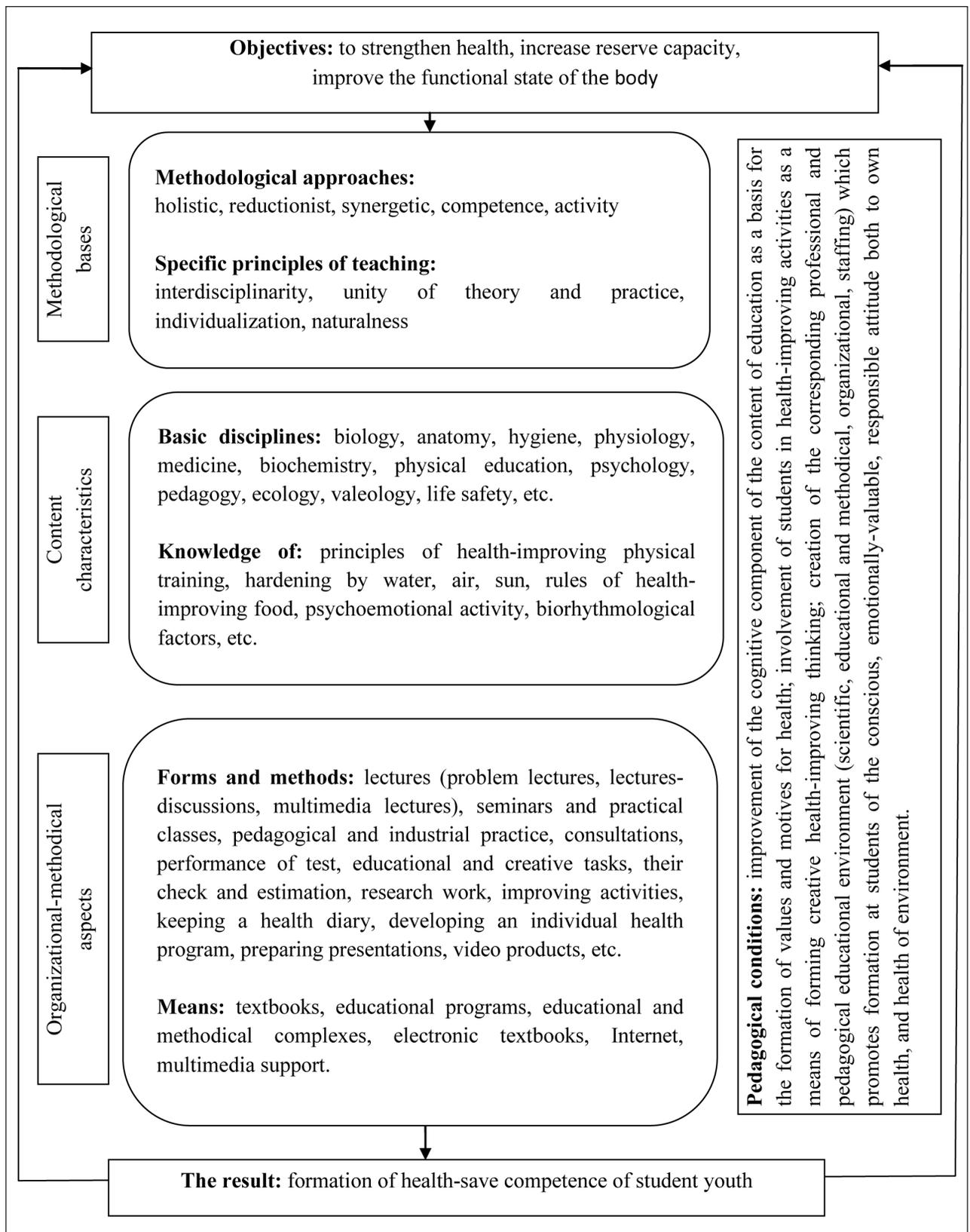


Figure 2. Preventive model of formation of health-save competence of student youth with the use of natural physiotherapy

exhalation for 61–90 seconds or more, heart rate from 59 to 67 beats per minute, Rufier index from 0.1 up to 5, blood pressure in the range of 111-120/71-75, vital signs 66-70 (men) and 56-60 (women), normal skin type, pink color, no acne, able to run 2 km in 9.00 minutes and faster (men) or in 11.00 minutes and faster (women), pull up on a horizontal bar 11 times or more (men) or perform 40 or more bends of the torso from a supine position, arms behind his head, legs fixed (women), jump length from a place 216 cm (men) or 156 cm (women), such students get colds no more than once a year or do not get sick at all ( $p < 0.05$ ).

The process of formation of health-save competence of students involves the creation of organizational and methodological conditions that help increase interest in health practices, improve the quality of life, the use of exercise as a means of natural physiotherapy. In order to organize and systematize this theoretical and practical experience, we have developed a preventive model of forming health-save competence of students, which allows to form an idea of the determinants of health, ways to strengthen it, guide students to follow the rules of healthy living and application of a wide range of natural physiotherapeutic means (Figure 2).

## DISCUSSION

Health-preserving competence includes a system of valeological knowledge, motor abilities and skills and involves the ability to organize and regulate health-preserving educational activities aimed at organizing a healthy lifestyle, preserving, strengthening and restoring the physical, mental, and social health of students, increasing the body's resistance to adverse environmental factors due to rationally organized motor activity, development and application of modern health-saving technologies, ensuring proper conditions for the normal life of students, mastering the basics of legislation on physical culture and sports, methods and means of physical education to optimize the educational process [20–22].

The organization of the process of formation of health competence of student youth requires the development and justification of basic conceptual, methodological principles, conceptual and terminological apparatus, basic principles of teaching, highlighting the range of necessary knowledge as a basis for understanding and further implementation in practice. The model is a theoretical construction that combines different in content and function structural components, the coordinated interaction and interrelation of which creates the conditions for achieving the result and goal.

In the context of this problem, the task is to determine the methodological approaches, the relationship and interaction of which determines the effectiveness of the learning process. Among such approaches, holistic, reductionist, synergetic, competence and activity are important.

The basis of the process of forming students' health-save competence is the content characteristics. This is a factor in the formation of both informational competencies and motivation for health activities, emotional and value, conscious

attitude to health. The disciplines, forms, methods and means of organization of the learning process listed in the model provide the necessary theoretical and practical experience for the formation of health-save competence of students using natural physiotherapy.

## CONCLUSIONS

The effectiveness of the process of forming the health-save competence of students is due to the use of various medical, psychological, pedagogical forms, tools, methods and their combination. Preventive model of forming health-save competence of student youth using natural physiotherapy as a theoretical construction systematizes and formalizes the idea of a holistic, multilevel, integrative, interdisciplinary educational process as a direction of pedagogical activity in a higher education institution.

Methodological approaches play a decisive role in the process of forming the skills of a healthy lifestyle, which form the basis for the integrity, system, effectiveness of both educational and practical and applied health activities. The methodological aspect of the preventive model takes into account both the features of the rehabilitation process and the learning process in terms of social and pedagogical spheres.

Significantly influence the process of formation of health-preserving competence of student youth pedagogical conditions as a set of measures consciously introduced by the teacher, external circumstances, factors that intentionally predict the achievement of the projected result.

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# Restoration of Working Capacity of Students after Physical Load in Exercises of a Cyclic Nature

## Regeneracja uczniów po ćwiczeniach o charakterze cyklicznym

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### SUMMARY

**Aim:** To investigate the impact of pedagogical means of working capacity restoration on students' results in exercises of a cyclic nature.

**Materials and Methods:** Research methods: theoretical analysis and generalization of literary sources, pedagogical observation, questionnaire, pedagogical experiment, methods of mathematical statistics. 58 students engaged in kettlebell lifting took part in the pedagogical experiment (28 students formed the experimental group, 30 – the control group). 123 coaches and 139 athletes who specialized in cyclic kinds of sports were involved in the survey.

**Results:** It was found out that pedagogical means of restoration and improvement of working capacity are the main ones in the process of training athletes in cyclic kinds of sports. It was determined that with the growth of the athletes' qualifications, the level of their knowledge and skills regarding the use of pedagogical means of restoration during the training process increases. It was established that the students of the experimental group achieved significantly better results in competitive exercises.

**Conclusions:** Scientifically based, purposeful and constant use of pedagogical means of restoration and improvement of working capacity both in the training process and beyond the educational and training process is a mandatory condition for improving competitive results in cyclic kinds of sports and is a good basis for maintaining high working capacity of student-athletes and preserving their health.

**Key words:** pedagogical means of restoration, working capacity, students, athletes

**Słowa kluczowe:** pedagogiczne środki odnowy, zdolność do pracy, studenci, sportowcy

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### INTRODUCTION

The age characteristics of student youth, the specifics of students' studies and way of life, the peculiarities of their opportunities and conditions for physical exercises make it possible to single out student sports in a special category. Student sports are a component of sports, cultivated in higher educational institutions (HEIs), integrating mass sports and sports of higher achievements [1, 2]. The scientists single out the following organizational peculiarities of student sports: availability and opportunity to engage in sports activities during the hours of mandatory training sessions in the academic discipline of "Physical Education" (an elective course in the main educational department or educational and training sessions in a sports educational department); opportunity to engage in

sports activities during the free time from academic studies in sports sections and groups of HEIs, as well as independently; opportunity to systematically participate in sports competitions of various levels (student competitions between faculties, courses of study, between HEIs, at the national and international levels in the chosen sport) [3, 4]. This whole system provides every practically healthy student with the opportunity to first familiarize himself/herself with and then choose a sport for regular training sessions. According to statistics, from 15 to 20% of students are engaged in student sports in HEIs of various countries [5]. Despite the significant time and energy spent on training, student-athletes, having a higher overall working capacity, can practically keep up with their fellow students in mastering the disciplines of the curriculum. They switch more easily from

one type of activities to another and psychologically are more resistant to stressful situations. As a result, the vast majority of student-athletes completes a full course of study at a HEIs and obtain a higher education [6].

The increase in the level of sports achievements of students is carried out not only due to the qualitative construction of the educational and training process, the selection of special physical training means, the rational technique of performing competitive exercises in the chosen sport, but also due to the effective use of means of working capacity restoration of their body. Restoration is the process of biological balancing of the body (its individual functions, organs, tissues, cells) after intense training and competitive loads [7]. Generally accepted means are used for a fuller and faster restoration of the body combined by scientists into three main groups: pedagogical, psychological and medical-biological [8]. The scientists [9, 10] have proven that pedagogical, psychological and medical-biological (pharmacological, physiotherapeutic) means accelerate the restoration processes of athletes both after individual trainings as well as competitions and after a large total volume of loads, increase general working capacity and provide prevention against over-fatigue. The central place in the restoration and stimulation of the working capacity of student-athletes is given to pedagogical means. During the educational and training process, they can be represented by: load planning and construction of the training process in accordance with the student-athlete's state of readiness; correspondence of loads with physical and psychological capabilities of students; correspondence of means with their volume and intensity of the period or stage of training; rational dynamics of loads in various structural formations of the educational and training process; special use of restoration exercises and training sessions; rational warm-up during training sessions and competitions; rational conduct of the final part of the training session in order to reduce emotional and physical excitement. The process of restoration and improvement of working capacity of athletes is also significantly influenced by the factors of life-sustaining activities, the conditions of the educational and training process as well as recreation. Therefore, the second part of restoration pedagogical means for students consists of: observing the routine of life and the educational and training process; compliance of conditions for training with sanitary and hygienic, ecological, technical requirements; compliance with the conditions for recreation and health protection of the student; harmonious combination of work (study) with sports; a clear and constant schedule of training, study, work and recreation; coordinated and rational use of individual and collective forms of educational and training sessions; preventing students from training sessions and competitions in case of their illness, acute and chronic injuries; taking into account the individual characteristics of students in the process of training, competitions, recreation and life-sustaining activities.

### AIM

The aim is to investigate the impact of pedagogical means of working capacity restoration on students' results in exercises of a cyclic nature.

## MATERIALS AND METHODS

Research methods: theoretical analysis and generalization of literary sources on the topic of the research, pedagogical observation, questionnaire, pedagogical experiment, methods of mathematical statistics.

The object of the research was the process of training students engaged in cyclic kinds of sports (running, sports walking, swimming, kettlebell lifting, cycling) for competitions. Coaches and athletes of Ukraine in cyclic kinds of sports of various qualifications took part in the survey: 16 – honoured coaches of Ukraine, 12 – head coaches and coaches of expansion teams, 58 – coaches with more than 8 years of experience, 37 – coaches with 1 to 2 years of experience, 22 – masters of sports of Ukraine of the international class (MSUIC), 34 – masters of sports of Ukraine (MSU), 83 – candidate masters of sports (CMS) and first-class athletes. 58 students of various higher educational institutions of the city of Zhytomyr took part in the pedagogical formative experiment, who were engaged in kettlebell lifting (28 students – experimental group [EG] and 30 – control group [CG]). The experiment was conducted in 2019-2021. The organizational and pedagogical conditions for conducting the pedagogical experiment covered the integrity of the process of training students of the EG with the use of scientifically based pedagogical means of restoration and stimulation of working capacity. The training sessions with the CG students did not provide for the accented use of pedagogical means of restoring working capacity.

The questionnaire of coaches and athletes was conducted to study their attitude to pedagogical, psychological, and medical-biological means of restoration, as well as to assess their theoretical knowledge and skills to use pedagogical means of restoration and stimulation of working capacity in the process of training for competitions. The survey was also conducted with the aim of identifying scientifically based implementation of pedagogical means of restoration and stimulation of students' working capacity in the process of their preparation for competitions. Knowledge and skills were assessed by us on the 100-point ECTS scale: high level – 90-100, sufficient – 82-89, average – 74-81, low – 60-73. The first three levels testify to a positive result: formed knowledge and high awareness of the athlete, while the low level requires education and improvement.

## RESULTS

Our analysis of the survey of coaches and athletes of various qualifications regarding the importance and value of using means of restoration and improvement of working capacity (pedagogical, psychological, medical-biological) showed both a clear trend towards their importance as well as significance in the process of training athletes in cyclic kinds of sports and a false attitude on the part of novice coaches and competitive sportsmen (Table 1). Highly qualified and experienced coaches as well as MSUIC and MSU clearly understand the importance of restoration means, as evidenced by the 1st ranking place given to pedagogical means. They explain this by the fact that a low level of physical and functional fitness can not be

**Table 1.** Assessment of the importance of using means of working capacity restoration by coaches and athletes of various qualifications (ranking place)

Qualification of coaches and athletes	Means of restoration of working capacity		
	Pedagogical	Psychological	Medical-biological
Honoured coaches of Ukraine	1	3	2
Head coaches of expansion teams	1	3	2
Coaches with more than 8 years of experience	2	3	1
Coaches with 1 to 2 years of experience	3	2	1
MSUIC	1	3	2
MSU	1	3	2
CMS and first-class sportsmen	3	2	1
Total ranking	1	3	2

**Table 2.** Athletes' assessment of pedagogical means of working capacity restoration during the educational and training process (points)

Pedagogical means of working capacity restoration	Qualification of athletes		
	MSUIC	MSU	CMS and first-class sportsmen
Correspondence of load planning and training configuration to the athlete's physical state	91.4	83.7	76.5
Correspondence of load to the athlete's state of readiness	92.1	81.9	75.7
Appropriateness of means, their volume and intensity of the training stage	90.2	83.3	74.6
Correspondence of load dynamics in the educational and training process	92.5	84.7	75.3
Use of restorative exercises and sessions in microcycles	93.6	85.2	74.1
Rational warm-up during training sessions and competitions	94.8	86.5	76.9
The use of restoration means during the final part of the training session	92.9	84.6	75.3
Average score	92.5	84.3	75.5

**Table 3.** Athletes' assessment of pedagogical means of working capacity restoration beyond the educational and training process (points)

Pedagogical means of working capacity restoration	Qualification of athletes		
	MSUIC	MSU	CMS and first-class sportsmen
Compliance with the routine of life and sports training	93.6	89.4	78.6
Compliance with sanitary, hygienic and environmental conditions for training	87.3	84.2	76.3
Conformity of conditions for recreation and health care	85.3	80.9	75.2
Harmonious combination of work (study) and sports	84.7	80.2	76.9
A clear and constant schedule of training, study, work and recreation	89.3	78.8	74.5
Rational use of individual and collective forms of training sessions	95.2	91.4	82.4
Preventing athletes from training sessions and competitions in case of their illness, acute and chronic injuries	98.6	93.2	84.7
Taking into account the individual characteristics of athletes in the process of training, competitions, recreation and life activities	93.5	91.7	80.3
Average score	90.9	86.2	78.6

**Table 4.** Dynamics of the results in competitive exercises of kettlebell-lifter students during the formative pedagogical experiment (Mean  $\pm$  SD, number of lifts)

Competitive exercises (24 kg kettlebell)	Experimental group		Control group		Difference between groups	The validity of the difference	
	Before the experiment	After the experiment	Before the experiment	After the experiment		t	p
Kettlebell push	67.3 $\pm$ 8.32	85.6 $\pm$ 8.93	68.2 $\pm$ 8.41	77.4 $\pm$ 8.75	8.2	2.37	<0.05
Kettlebell jerk	98.7 $\pm$ 9.34	129.8 $\pm$ 9.87	100.3 $\pm$ 9.76	119.7 $\pm$ 9.83	10.1	2.65	<0.05
Double-event	166.0 $\pm$ 9.47	215.4 $\pm$ 9.14	168.5 $\pm$ 9.37	197.1 $\pm$ 9.65	18.3	2.83	<0.05
Long cycle	31.6 $\pm$ 7.43	46.8 $\pm$ 7.74	32.5 $\pm$ 7.40	39.3 $\pm$ 7.49	7.5	2.13	<0.05

Legend: Mean – arithmetical average; SD – standard deviation; t – Student's t-test value; p – the significance of the difference between the students' indicators at the end of the experiment

fully compensated by medical-biological and psychological means. At the same time, novice coaches and competitive sportsmen believe that it is possible to overcome shortcomings in the process of physical, technical, tactical and functional preparation of an athlete with the help of medico-biological and psychological means, which is a false opinion.

Pedagogical means of restoration of working capacity are used directly in the process of educational and training classes and provide for a rational distribution of loads within monthly and weekly cycles and periods of preparation during training sessions. Different restoration methods are used in training sessions including switching muscles from one exercise to another; exercises performed with different regimes and tempos, from different starting positions and in difficult movement conditions, i.e. specially organized muscle activities. The research we conducted showed a high and sufficient level of knowledge and practical application of pedagogical means of restoration of working capacity of the MSUIC and the MSU during the training process, respectively 92.5 and 84.3 points (Table 2). At the same time, the CMS and the first-class sportsmen do not have enough and do not always use the necessary pedagogical means of restoration of working capacity during the training process, as evidenced by the average score of 75.5 points.

An important place in the process of training athletes is occupied by means of working capacity restoration, which are used in life-sustaining activities beyond the educational and training process, namely: compliance with the daily routine, compliance with living and resting conditions; combination of work, study and training process; the use of individual and collective forms of training, compliance with the rules of restoration after injuries and illnesses, etc. The research has confirmed that the qualifications of athletes confirm a high level of possession and application by athletes of pedagogical means of working capacity restoration beyond the educational and training process, respectively, MSUIC showed 90.9 points, MSU – 86.2 points, CMS and first-class sportsmen – 78.6 points (Table 3). This indicates the fact that athletes learn to correctly use pedagogical means of restoration with the improvement of their sports skills.

Possibilities of pedagogical means of restoration were reflected in the sections on configuring the process of training students who specialize in kettlebell lifting. A particularly important role is played by the psychological climate in the course of educational and training sessions and competitions, as well as the organization of recreation and leisure activities, taking into account the specifics of work and educational activities. Pedagogical means of restoration are aimed at increasing general and special physical fitness, improving health, increasing working capacity, the level of development of physical qualities, harmonious physical fitness. During the experiment, we widely used restoration exercises for active stretching (hanging on a crossbar or rings, swinging and rocking the trunk, circular movements with the legs or trunk, body bending with weight, hanging on the bars with weights attached to the legs, extending the arms at the elbow joints, lifting legs hanging on the crossbar, turns of the

body with a barbell on the shoulders, leg lifts while lying on a bench, etc.); exercises for passive stretching (hanging on the crossbar with a narrow or wide grip, lying on an inclined bench with your head down, stretching the front group of thigh muscles (weight on the shins), stretching the extensors of the spine, stretching the body in water, bending the body, etc.); unloading exercises (lying on a bench, barbell leg press, sitting press, barbell push from the chest with alternating legs forward, jumps up with one or two legs push, long jumps from a standing position and from a run); preventive exercises (leaning forward with a light weight on the shoulders, hyperextension, pulling the barbell with a narrow and wide grip, exercises for the abdominal muscles, exercises on the leg machines, raising the torso with a barbell on an inclined bench, head down). The recommended sets of exercises were performed both during the warm-up and in the final part of the training session. The exercises were performed between the sets of exercises with kettlebells during the main part of the training session.

The use of the above sets of exercises and pedagogical means of restoration in the training process and in daily life by the kettlebell-lifters of the experimental group under the coaches' supervision made it possible to significantly improve the results in competitive exercises ( $p < 0.05$ ) (Table 4).

This gives grounds for asserting that in kettlebell lifting, it is quite important that the phase of muscles tension alternates with the phase of their relaxation during the period of intensive cyclic work of muscles for strength endurance. In order to prevent micro traumas, it is necessary that the amount and quality of strength load correspond to the duration of rest (relaxation type). Therefore, it is necessary to use exercises with active and passive stretching, pedagogical means of restoration and active rest in the course of training sessions with strength exercises between sets or at the end of their performance.

## DISCUSSION

Fatigue, which occurs during strenuous muscle activities, is formed specifically for each type of training work, depending on the degree of participation in its performance of various functional systems and mechanisms. In such a case, each restorative procedure also has its own specific effect on the body, depending on the nature and method of its application. Therefore, it is very important to combine training effects and restorative procedures, which must strictly take into account their effects on the body. Such changes especially occur when special endurance is detected in athletes in cyclic kinds of sports, namely: water-salt imbalance, consumption of energy substances, decrease in lipolytic functions of the liver, functional proteinuria and hematuria due to insufficient oxygen and blood supply to the kidneys during loads, acidosis, structural disorders of biological membranes, a decrease in the protective functions of the immune system and other phenomena that determine the natural fatigue of important functional systems of the body [11, 12]. At the same time, the main efforts to restore the body's functions should be aimed at promoting the natural restoration of biosynthesizing processes.

According to many scientists [13, 14], the use of restoration means can not only reduce the student's fatigue, but also speed up restoration processes. At the same time, each restorative procedure in itself is an additional burden on the body, which places certain demands on the activities of various functional systems of the body. Ignoring this can result in the reverse effect of additional means i.e. increased fatigue, reduced working capacity, disruption in the course of adaptation processes and the occurrence of other negative reactions. Therefore, it is necessary to take into account training effects and restoration procedures as two sides of a single complex process. Combining means of restoration and training effects into a certain system is one of the main issues of managing working capacity and restoration processes during physical exercises [15].

Regarding the effectiveness of pedagogical means of working capacity restoration, the scientists [16-18] indicate that the correct selection of means and methods of their application in the main part of the training session ensures the necessary level of working capacity and emotional state of athletes. Compensatory work, i.e., exercises that are performed at intensity lower than the threshold of anaerobic metabolism – 30-50%  $\text{VO}_2 \text{ max}$  – is of great importance as a pedagogical means of restoration. Such work ensures intensive blood exchange in the muscles and does not lead to the production of lactate, but, on the contrary, contributes to the process of its elimination. Therefore, low cyclic work on endurance is an effective means of rapid restoration of processes between training and competitive exercises [8]. It was proven that training sessions with small and medium loads are active factors in the management of restoration processes after training sessions with heavy loads. At the same time, the intensification of restoration processes after training sessions with heavy loads is observed only in the case when work of a fundamentally different direction is used in the course of additional training sessions, during the performance of which the working capacity is determined mainly by the functioning of other systems and mechanisms.

In general, pedagogical means are closely related to the rational configuration of various links in the process of training a student-athlete, starting from the selection of training exercises to the construction of training sessions that can contribute to the positive course of restoration processes after certain exercises and loads. Herewith, it is necessary to take into account that the positive course of restoration processes is facilitated by a positive psychological microclimate during training sessions and competitions, rational recreation and leisure.

## CONCLUSIONS

1. Questionnaires of coaches and athletes of various qualifications confirmed the hypothesis that pedagogical means of restoration of working capacity are the main ones in the process of training athletes. Thus, during the survey, qualified coaches, MSUIC and MSU gave preference to pedagogical means of restoration, commenting on this that deficiencies in physical and functional preparation

can not be fully compensated by medical-biological or psychological means of restoration. At the same time, the majority of novice coaches and athletes having CMS grade and the first-class sportsmen are characterised by false concepts and knowledge that the desired sports result can be achieved due to medical-biological and psychological means. This shows that the training of students i.e. future sports coaches requires necessary corrections to the training programs during the study of the section of "Means of restoration and improvement of working capacity of athletes".

2. The research confirmed that with the growth of the athletes' qualifications, the level of their knowledge and skills regarding the use of pedagogical means of restoration of working capacity during the training process increases, respectively. So, in particular, MSUIC showed a high level of knowledge – 92.5 points, MSU – 84.3 points, CMS and first-class sportsmen – 75.3 points. At the same time, the use of pedagogical means of restoration beyond the training process revealed a number of reasons that do not contribute to the full restoration of the body, namely: the inconsistency of sanitary, hygienic and environmental conditions for training, recreation and health care; lack of opportunity to combine work or study with sports; lack of a constant schedule of training, study, work and recreation; insufficient material and technical equipment of places for training and recreation.
3. The conducted pedagogic formative experiment confirmed that scientifically based, purposeful and constant use of pedagogic means of restoration of working capacity both in the training process and beyond the educational and training process is a mandatory condition for increasing the level of sports achievements in cyclic kinds of sports, is a good basis for supporting the high working capacity of student-athletes and preserving their health. During the experiment, the kettlebell-lifter students of the experimental group achieved significantly better results and showed significantly ( $p < 0.05$ ) better results in competitive exercises, in particular, the rate of growth made 8.2 times in the kettlebell push, the kettlebell jerk – 10.1 times, the sum of the double-event – 18.3 times, the long cycle – 7.5 times. At the same time, the majority of students in the control group preferred passive restoration methods, which involve the use of temperature factors, water procedures and restorative massage.

Prospects for further research are aimed at studying the attitude of student-athletes to the use of psychological means of restoration.

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# Dependence of Students' Health on the Organization of their Motor Activity in Higher Educational Institutions

## Wpływ organizacji aktywności ruchowej studentów na uczelniach na stan ich zdrowia

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### SUMMARY

**Aim:** To investigate the impact of the peculiarities of the organization of students' motor activity on their health in the learning process.

**Materials and Methods:** The research involved 164 students (93 men and 71 women) from two higher educational institutions. The research was conducted in 2017-2021 and included carrying-out the comparative analysis of the peculiarities of the organization of physical education in two institutions and the research of their impact on students' health. The state of students' health was studied in terms of the indicators of their body length and weight, lung capacity, hand dynamometry, heart rate, blood pressure and level of physical health.

**Results:** It was found that the main difference in the organization of motor activity of students in the studied institutions is the total number of hours provided for the study "Physical Education" academic subject during the years of attendance: compulsory training sessions are held for 4 years in one institution and for 2 years in the other. It was found that the students whose physical education training sessions were conducted throughout the entire study period had significantly better health indicators; there was an increase in the number of students with average, above-average and high levels of physical health.

**Conclusions:** The obtained results show that the peculiarities of the organization of motor activity of students in the higher educational institution have a significant impact on their health, which will help improve their future life-sustaining activities.

**Key words:** health, motor activity, physical education, students

**Słowa kluczowe:** zdrowie, aktywność ruchowa, wychowanie fizyczne, uczniowie

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### INTRODUCTION

There are many global problems in modern education including vital ones among them the solution of which predetermines the existence of not only the educational system but also society as a whole. This is a matter of students' health, which, unfortunately, has been a major concern in recent years [1-3]. Constant mental and emotional stress, information stress, low motor activity, lack of material security, irrational lifestyle, pernicious habits, etc. play not the least role among the factors that negatively affect the health of young people [4, 5].

The results of numerous studies [6-8] show that the level of health of student youth in recent years is becoming critical.

The researchers note that most students have health problems and low levels of physical fitness at the time of their admission [9, 10]. Their health indicators are being deteriorated over the years of study in higher educational institutions (HEIs). The experts believe the low efficiency of the current system of functioning of physical education in HEIs to be one of the reasons for this situation. The scientists note that the system of physical education of students requires radical changes, first and foremost in organizational and methodological support [11, 12].

The problem of maintaining the health of students at the present stage of development of the higher education system

has become a priority. Strengthening and maintaining the health of students in HEIs should be carried out on the basis of productive improvement of the educational process of physical education, taking into account modern requirements for specialists' training as carriers and promoters of physical culture in future professional activities and family life [13, 14]. Modern educational activities are intensive in nature of specialists' training that meets the socio-economic requirements of society and the state, which are constantly changing; at the same time it is necessary to ensure the development of the individual taking into account his/her needs, abilities, values, including motor skills as a prerequisite strengthening and maintaining health, realizing the intellectual and physical potential of current and future professionally trained youth [15, 16].

In recent years, a large number of studies have been conducted to improve the system of physical education in HEIs in order to improve the health of students [17-19]: the scientists proposed different approaches to improving physical, theoretical, methodological training of students, monitoring activities; they develop modern technologies to improve exercises and substantiate methods of using innovative technologies based on modern types of motor activity, interactive teaching methods, sports-oriented physical education, computer technology, etc. However, in the context of reforming higher education, the study of the dynamics of students' health in the process of their studies in HEIs is especially relevant as the most informative indicator of the effectiveness of the physical education system.

### AIM

The aim is to investigate the impact of the peculiarities of the organization of students' motor activity on their health in the learning process.

### MATERIALS AND METHODS

The research involved 164 students (93 men and 71 women) from two institutions of higher education in Ukraine: Ukrainian State University of Chemical Technology (USUCT (n=84), 49 men, 35 women) and Zhytomyr Ivan Franko State University (ZHSU) (n=80), 44 men, 36 women). The research was conducted in 2017-2021. It included carrying-out the comparative analysis of the peculiarities of the organization of physical education in two HEIs and the research of the impact of these peculiarities on students' health.

The state of students' health was studied in terms of the indicators of their body length and weight, lung capacity (LC), hand dynamometry, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), body mass index (BMI) and level of physical health. The level of students' physical health was assessed according to the method of H.L. Apanasenko [20]. The study of these indicators was carried out in the dynamics i.e. during the period of study of students in the HEI from the 1<sup>st</sup> to the 4<sup>th</sup> instructional year. These indicators were obtained during the annual survey of students in relevant medical institutions by health professionals. The authors of the article processed the obtained indicators, assessed the reliability of the difference between them, interpreted

the obtained data and formulated scientific conclusions and recommendations.

Research methods: theoretical analysis (provided study of 25 sources on the topic of the article from the scientometric databases Web of Science Core Collection, PubMed, Scopus, Index Copernicus, Google Scholar and others), documentary method (provided study of the working documentation of physical education departments of two HEIs for the comparative analysis of the peculiarities of physical education), medical and biological methods (provided assessment of anthropometric and physiometric indicators of students), statistical methods (used to determine the reliability of the difference between the studied indicators of students of different HEIs, correct processing of results and formulating sound conclusions). During the research the authenticity of difference between the indicators of students was determined by means of Student's t-test.

This research complies with the ethical standards of the Act of Ukraine "On Higher Education" No.1556-VII dated 01.07.2014 and the Letter from the Ministry of Education and Science of Ukraine "On the Academic Plagiarism Prevention" No.1/11-8681 dated 15.08.2018. Also, this research followed the regulations of the World Medical Association Declaration of Helsinki – ethical principles for medical research involving human subjects. Informed consent was received from all individuals who took part in this research.

### RESULTS

The analysis of the working educational documentation of the departments of physical education of the two HEIs shows that the peculiarities of the organization of physical education of students in these HEIs have certain differences concerning the duration of "Physical Education" academic subject depending on the instructional year, the number of academic hours provided for the subject mastery, approaches to the basic and elective components of the curriculum, sports as well as fitness and health recreation systems presented in the curriculum, organization of fitness and health recreation as well as sports events during extracurricular activities. Thus, the study of "Physical Education" academic subject in USUCT is carried out during the entire years of attendance at the first "bachelor's" level of higher education for 4 hours a week. Four modules on the following sports are planned in each semester: track-and-field athletics, gymnastics, game-oriented sports, swimming. Students are not given the opportunity to choose a sport during their training sessions. During the extracurricular activities, the students have the opportunity to attend training sessions in sports sections or sports and health groups available on the basis of the sports facilities of the university. At ZHSU, compulsory training sessions are held only during the 1<sup>st</sup> and the 2<sup>nd</sup> instructional years for 4 hours a week. Each semester contains two modules. The 1<sup>st</sup> module is basic and includes elements of track-and-field athletics, gymnastics, game-oriented sports and swimming. The 2<sup>nd</sup> module is elective one and provides students the opportunity to freely choose the sport from those offered by the HEI: badminton, basketball, volleyball, table tennis, track-and-field athletics, swimming, fencing, shaping, athletic

gymnastics, taekwondo, orienteering. During the extracurricular activities, a section on various sports and health-improving physical culture was organized on the basis of the ZHSU sports facilities. Training sessions in the sections are free for students (the number of training sessions is not limited).

One of the priority tasks currently facing specialists in the field of physical education is to improve the system of both practical and theoretical as well as methodological training of students. Theoretical material forms a worldview system of scientific and practical knowledge and attitudes of students to physical culture. Methodical skills provide an opportunity to creatively use the acquired knowledge for professional and personal development, self-improvement, organization of a healthy lifestyle and, in particular, motor activity, which indirectly affects the physical state of students. Therefore, we paid close attention to the peculiarities of the organization of theoretical and methodological training of students within the system of physical education.

Theoretical training in USUCT is implemented in the form of short reports from the teacher (10-15 minutes) during practical training sessions and individual consultations. Lectures on physical education are not provided by the curriculum. Each semester provides consideration of four topics from the section of theoretical and methodical preparation with developed tasks for independent preparation, advancement questions and the list of the recommended literature. The academic performance rating of students' is carried out on the quality of oral answers and performance of self-preparation tasks. Scientific conferences, debates, round tables in extracurricular activities are held for students on the problems of physical education during their extracurricular activities. The students obtain additional points during the final certification for participation in such events. ZHSU provides 2 hours of training sessions in each semester and

4 hours of independent training to study the theoretical and methodological sections of the curriculum in the basic and elective components. The department has developed the topics of theoretical preparation and the content of lecture material for the entire period of attendance, provided the list of topics for independent work of students and the list of recommended reading. The main form of final control in both HEIs is the pass/fail exam, which is taken at the end of each semester. Thus, the main difference in the organization of physical education of students in the studied HEIs is the total number of hours provided for the study of "Physical Education" academic subject during the entire years of attendance.

The results of the analysis of the dynamics of the indicators that characterize the health of students of the two HEIs are presented in Table 1 (male students) and Table 2 (female students). The analysis of the indicators that characterize the state of health of students shows that there were no statistically significant differences between the representatives of different HEIs on any of the parameters measured during the research during the 1<sup>st</sup> instructional year ( $p > 0.05$ ). The average values of all indicators corresponded to age normative standards.

The comparative analysis of the indicators that characterize the state of health of students in the two HEIs showed that in USUCT, in contrast to ZHSU, all the studied parameters tend to improve over the period of studies. However, in the dynamics of learning from the 1<sup>st</sup> to the 4<sup>th</sup> instructional years, none of the studied students in the HEIs, both men and women, revealed statistically significant changes in body length, body weight, body mass index, systolic blood pressure and diastolic blood pressure ( $p > 0.05$ ). The male students of USUCT showed a significant ( $p < 0.05$ ) improvement in such indicators as LC – by 325 ml, heart rate at rest – by 4.8 beats/min<sup>-1</sup>, dynamometry of a stronger hand – by 6.1 kg.

**Table 1.** Dynamics of the indicators that characterize the state of health of students (men) of the two HEIs, in the process of their studies during the 1<sup>st</sup>-4<sup>th</sup> instructional years, Mean $\pm$ SD

Indicators	USUCT (n=49)				ZHSU (n=44)			
	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>d</sup> year	4 <sup>th</sup> year	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>d</sup> year	4 <sup>th</sup> year
Body length, cm	178.8 $\pm 7.36$	179.2 $\pm 7.14$	179.3 $\pm 7.27$	179.3 $\pm 7.15$	177.5 $\pm 6.92$	177.8 $\pm 6.58$	177.8 $\pm 6.73$	177.4 $\pm 6.82$
Body weight, kg	68.8 $\pm$ 8.14	71.4 $\pm$ 8.96	70.9 $\pm$ 8.53	71.6 $\pm$ 8.54	68.9 $\pm$ 8.36	70.2 $\pm$ 7.47	70.4 $\pm$ 7.16	71.2 $\pm$ 6.94
BMI, kg/m <sup>2</sup>	21.77 $\pm 2.44$	22.31 $\pm 2.57$	22.15 $\pm 2.54$	22.37 $\pm 2.56$	22.01 $\pm 1.98$	22.42 $\pm 2.21$	22.49 $\pm 2.13$	22.74 $\pm 1.92$
LC, ml	3545.0 $\pm 601.0$	3660.0 $\pm 690.0$	3790.0 $\pm 720.0$	3870.0* $\pm 602.0$	3565.0 $\pm 620.0$	3780.0 $\pm 730.0$	3650.0 $\pm 780.0$	3590.0 $\pm 730.0$
HR, beat/min <sup>-1</sup>	73.3 $\pm$ 6.62	71.1 $\pm$ 7.38	69.2 $\pm$ 7.06	68.5* $\pm$ 7.25	73.8 $\pm$ 8.14	73.6 $\pm$ 7.85	74.3 $\pm$ 5.57	74.9 $\pm$ 7.83
SBP, millimeter of mercury	121.3 $\pm 4.37$	121.9 $\pm 4.10$	122.1 $\pm 5.32$	122.1 $\pm 4.94$	120.8 $\pm 3.97$	122.0 $\pm 4.28$	122.3 $\pm 4.84$	122.5 $\pm 4.63$
DBP, millimeter of mercury	79.3 $\pm$ 3.11	80.0 $\pm$ 3.45	80.2 $\pm$ 4.13	80.1 $\pm$ 3.85	79.4 $\pm$ 3.97	79.6 $\pm$ 4.72	80.3 $\pm$ 4.66	81.1 $\pm$ 4.91
Hand dynamometry, kg	44.1 $\pm$ 9.22	46.0 $\pm$ 8.95	48.3 $\pm$ 9.64	50.2* $\pm$ 8.77	43.8 $\pm$ 9.19	45.9 $\pm$ 8.85	45.6 $\pm$ 8.33	46.1 $\pm$ 7.86

Note: Mean – arithmetical average; SD – standard deviation; \* – the reliability of the difference between the indicators of the 1<sup>st</sup>-4<sup>th</sup> instructional years at  $p < 0.05$

**Table 2.** Dynamics of the indicators that characterize the state of health of students (women) of the two HEIs, in the process of their studies during the 1<sup>st</sup>-4<sup>th</sup> instructional years, Mean±SD

Indicators	USUCT (n=35)				ZHSU (n=36)			
	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>d</sup> year	4 <sup>th</sup> year	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>d</sup> year	4 <sup>th</sup> year
Body length, cm	166.4 ± 3.63	166.4 ± 3.84	166.4 ± 3.84	166.4 ± 3.84	165.9 ± 3.16	166.0 ± 3.54	166.0 ± 3.54	166.0 ± 3.54
Body weight, kg	57.3 ± 8.01	57.9 ± 7.64	58.5 ± 6.95	58.8 ± 7.57	57.3 ± 8.25	58.9 ± 8.28	59.2 ± 7.98	59.7 ± 7.8
BMI, kg/m <sup>2</sup>	20.83 ± 5.43	21.05 ± 5.24	21.27 ± 6.16	21.38 ± 6.57	20.91 ± 4.18	21.41 ± 5.39	21.87 ± 6.20	22.03 ± 5.88
LC, ml	2500.0 ±620.0	2610.0 ±602.0	2610.0 ±687.0	2845.0* ±590.0	2590.0 ±650.0	2725.0 ±695.0	2650.0 ±650.0	2600.0 ±705.0
HR, beat/min <sup>-1</sup>	73.9 ± 7.91	72.3 ± 6.82	70.9 ± 7.26	69.8* ± 6.52	73.5 ± 6.15	72.9 ± 8.72	74.2 ± 7.96	74.9 ± 10.23
SBP, millimeter of mercury	118.3 ± 4.33	119.1 ± 3.98	119.1 ± 4.15	120.2 ± 3.99	119.7 ± 4.87	119.2 ± 4.66	120.0 ± 3.21	120.1 ± 3.76
DBP, millimeter of mercury	79.1 ± 4.26	78.7 ± 4.41	77.6 ± 3.41	77.2 ± 4.41	78.8 ± 4.69	78.6 ± 4.19	77.9 ± 4.87	78.9 ± 3.79
Hand dynamometry, kg	19.8 ± 6.34	22.3 ± 7.19	24.6 ± 7.16	25.8* ± 6.87	20.7 ± 7.27	21.4 ± 6.98	21.8 ± 7.35	21.6 ± 7.35

Note: Mean – arithmetical average; SD – standard deviation; \* – the reliability of the difference between the indicators of the 1<sup>st</sup>-4<sup>th</sup> instructional years at  $p < 0.05$

ZHSU male students also showed a positive dynamics of most indicators in the process of their studies only during the 1<sup>st</sup> and the 2<sup>nd</sup> instructional years, while students attended physical education training sessions. However, during the 3<sup>rd</sup> and the 4<sup>th</sup> instructional years most indicators deteriorated relative to the 2<sup>nd</sup> one.

The dynamics of the indicators of female students of both HEIs has a similar trend of change as that of male students: changes in all studied parameters are positive from the 1<sup>st</sup> to the 4<sup>th</sup> instructional years in USUCT, and changes are characterized by positive dynamics only during the 1<sup>st</sup> and the 2<sup>nd</sup> instructional years in ZHSU, and the indicators tend to deteriorate during senior instructional years.

Thus, the analysis of the indicators that characterize the health of female students of USUCT, showed that the indicators of LC significantly ( $p < 0.05$ ) improved during the study period by 345 ml, heart rate at rest – by 4.1 beats/min<sup>-1</sup>, hand dynamometry – by 6 kg. None of the studied parameters changed significantly in terms of statistics in ZHSU female students during the period of study in HEI ( $p < 0.05$ ). Moreover, there is a tendency to their gradual deterioration in the dynamics of some indicators.

The analysis of the results of the study of physical health of male students according to the method of H.L. Apanasenko shows that most students of both HEIs had low and below-average levels of physical health during the 1<sup>st</sup> instructional year. Thus, 40.8 % of USUCT students and 40.9% of ZHSU students had low levels of physical health among male students. Below-average level of physical health was observed in 36.7% of USUCT students and 36.4% of ZHSU students. 22.5% of USUCT students and 22.7% of ZHSU students had an average level of physical health (Table 3).

There has been a steady trend of improving the physical health of male students during their studies at USUCT. Thus, during the 4<sup>th</sup> instructional year the number of students with

a low level of health decreased to 34.7%, with a below-average level – to 34.7%, and with an average level increased to 30.6%, while 4.1% of students were identified with an above-average level of physical health. There is an improvement in the health of male students of ZHSU only during the 2<sup>nd</sup> instructional year and its deterioration during the senior instructional years. Moreover, the health indicators were worse during the 4<sup>th</sup> instructional year than during the 1<sup>st</sup> one: the number of students with low and below-average levels increased to 43.2%, and the number of students with an average level decreased to 13.6%.

There is a similar trend in the female health indicators of female students of the two HEIs: USUCT students improved during the entire years of attendance, and ZHSU students did it only during the junior instructional years with deterioration during the senior instructional years. The ratio of the number of students in both institutions in terms of the levels of their health was almost the same at the beginning of the study. Among USUCT first-year students, 34.3% had a low level of physical health, 51.4% – a below-average level, and 14.3% – an average level; among ZHSU female students, 33.3% had a low level of health, 50.0% – a below-average level of health, and 16.7% – an average level of health. During the 4<sup>th</sup> instructional year, the number of USUCT female students with a low level decreased to 22.9%, with a below-average level – to 42.9%, and with an average level – increased to 25.7%. Moreover, USUCT had 14.2% of female students with above-average level of health and 2.9% with high level of health at the end of their studies. In ZHSU, on the other hand, the 4<sup>th</sup> instructional year revealed an increase in the number of female students with a low level of health (up to 41.7%) and a decrease in the number of female students with an average level (up to 11.1%). However, no ZHSU female students had above-average and high levels of physical health at the end of their study.

**Table 3.** The ratio of the levels of physical health of students of different HEIs, %

Levels of physical health	USUCT				ZHSU			
	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>d</sup> year	4 <sup>th</sup> year	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>d</sup> year	4 <sup>th</sup> year
Male students								
Low	40.8	36.7	32.6	30.6	40.9	34.1	38.6	43.2
Below-average	36.7	40.8	36.7	34.7	36.4	50.0	43.2	43.2
Average	22.5	22.5	26.5	30.6	22.7	15.9	18.2	13.6
Above-average	–	–	4.1	4.1	–	–	–	–
High	–	–	–	–	–	–	–	–
Female students								
Low	34.3	28.6	25.7	22.9	33.3	30.5	38.9	41.7
Below-average	51.4	54.3	51.4	42.9	50.0	41.7	44.4	47.2
Average	14.3	17.1	20.0	25.7	16.7	27.8	16.7	11.1
Above-average	–	–	2.9	14.2	–	–	–	–
High	–	–	–	2.9	–	–	–	–

## DISCUSSION

Health directly affects the ability to work and productivity, the country's economy, the moral climate in society, the upbringing of the younger generation, reflects the way and quality of life [21, 22]. A healthy lifestyle is an important preventative factor in promoting good health. Attention to one's own health, the ability to ensure individual prevention of its disorders, conscious focus on the health of various forms of life sustaining activities are all indicators of the general culture of a human being [23, 24].

The problem of lifestyle and health of students is relevant in today's socio-economic environment. The health of this generation largely determines the health of future generations. The health of students, along with their social maturity, is a necessary condition for studying in the HEI and hence high professional suitability.

The research of the scientists [2, 4, 7, 9, 25] states that one of the reasons for the deterioration of the health of student youth of Ukraine is the imperfect organization of physical education in HEIs, which is in conflict with the goals of pedagogy. If we summarize the essence of the shortcomings in the system of physical education of students in HEIs, as well as proposals and requirements made by teachers for its reform, it becomes clear that the necessary solutions can only be found in the ways to rationalize physical education as a component of integrated educational process. As a result of the comparative analysis of the organizational peculiarities of the physical education system in the two HEIs, we found that compulsory physical education training sessions were held for 4 years 4 hours a week in USUCT, and training sessions in ZHSU were held for 2 years 4 hours a week. At the same time, USUCT paid much more attention, as contrasted with ZHSU, to the issues of theoretical and methodological training as a basis for forming students' worldview on the organization of a healthy lifestyle that indirectly affects the level of students' health. As a result, USUCT students, both male and female, had significantly better indicators of health at the end of their studies in the HEI (during the 4<sup>th</sup> instructional year) than ZHSU students.

The results confirm the conclusions of many scientists, who indicate that the HEI with more effective functioning system of physical education is also characterised by quite high level of students' health. Thus we expanded and supplemented data on the content and organization of physical education in various HEIs; on the impact of organizational peculiarities of physical education upon the indicators of physical health of students.

## CONCLUSIONS

1. The analysis of the working educational documentation of the departments of physical education of the two HEIs shows that the peculiarities of the organization of physical education of students in these HEIs have certain differences, which primarily relate to the duration of "Physical Education" academic subject. Compulsory training sessions in USUCT are held during the entire years of attendance at the first "bachelor's" level of higher education (4 years) and during the 1<sup>st</sup> and the 2<sup>nd</sup> instructional years in ZHSU.
2. Comparison of the indicators that characterize the state of students' health in different HEIs in the dynamics of their education shows that they did not have statistically significant differences during the 1<sup>st</sup> instructional year ( $p > 0.05$ ). USUCT students (both men and women) showed a decrease during the period from the 1<sup>st</sup> to the 4<sup>th</sup> instructional years in heart rate at rest, improvement of the indicators of LC and hand dynamometry ( $p < 0.05$ ), increase in the number of students with average, above-average and high levels of physical health. ZHSU students did not experience significant changes in physical health during the research period ( $p > 0.05$ ).
3. The obtained results show that the peculiarities of the organization of motor activity of students in HEIs have a significant impact on their state of health during and after their years of attendance.

Prospects for further research are aimed at assessing the level of physical health of students during distance learning in quarantine.

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# Technology of Increasing Physical Activity of University Students

## Metody zwiększania aktywności fizycznej studentów szkół wyższych

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### SUMMARY

**Aim:** To check the effectiveness of authors' technology of increasing physical activity of university students.

**Materials and Methods:** The research involved 369 students (including 197 males and 172 females). All students were divided into control (CG) and experimental groups (EG). The EG included 188 students (105 males, 83 females), the CG – 181 students (92 males, 89 females) respectively. The effectiveness of authors' technology was assessed by the following indicators: the amount of physical activity; the dynamics of students' physical fitness during four years of studying.

**Results:** The results of the experiment show that authors' technology contributes to increasing the amount of students' physical activity and improving the level of their physical fitness. The students (both males and females) of the EG were recorded to have significantly better indicators than the CG.

**Conclusions:** The experimental work confirmed the effectiveness, functionality and adaptability of the authors' technology of increasing physical activity of university students. A high level of physical activity of students will contribute to strengthening their health and improving the efficiency of their future professional activities.

**Key words:** physical activity, fitness, physical education, students

**Słowa kluczowe:** aktywność fizyczna, sprawność fizyczna, wychowanie fizyczne, studenci

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### INTRODUCTION

Modern society requires the theory and practice of higher education institutions (HEI) to direct the accumulated scientific experience at the basis of the formation of a new structure of competent professionals who can think creatively, navigate in the information space, master worldview paradigms on their own and systematically maintain their health and high mental and physical capacity. As a result, the need for effective preparation of students for independent creative and research activities and the ability to maintain their physical condition has significantly increased [1-3]. It developed in a need to update the educational process in HEI owing to its focus on the model of the future professional activity of graduates under conditions of introducing effective technologies for organizing the educational process, which will promote the formation of personality with creative thinking

and a healthful mind [4, 5]. The system of physical education is a historically determined type of the social practice of physical education, which is based on ideological, normative program, scientific, methodical, and organizational principles that provide the physical education of different segments of the population [6, 7]. One of the main elements of the physical education system functioning is normative programs and regulations, the central element of which are educational programs that determine the amount of knowledge, skills, the level of physical development and physical fitness, health, and others. In modern society, the functions of the physical education of university students are being changed significantly. The functions of physical education are often aimed at providing services, which focus on having appropriate leisure and ensuring a healthy lifestyle, i.e. they acquire a social dimension [8, 9].

The system of physical education in Ukraine does not meet the natural biological needs of students in physical activity, does not provide students with the necessary level of health, physical fitness, theoretical knowledge, motivation, scientifically sound educational and health technologies that can be used later in life. There is a contradiction between the students' needs for worldview, spiritual, cultural, intellectual enrichment and the need for physical improvement [10, 11].

### AIM

The aim is to check the effectiveness of authors' technology of increasing physical activity of university students.

### MATERIALS AND METHODS

The research was conducted at Zhytomyr Ivan Franko State University (Ukraine) in 2017-2022. The pedagogical experiment involved 369 students (including 197 males and 172 females) of the different faculties. All students were divided into control (CG) and experimental groups (EG) by the methods of even distribution of groups. The experimental groups included 188 students (105 males, 83 females), the control groups – 181 students respectively (92 males, 89 females). According to the schedule, physical education classes were held twice a week in the first part of the day in all groups.

The authors' technology was introduced into the educational process of the students of experimental groups. The characteristic features of the newly created technology include: scientifically sound planning of the process of physical education; unity and interrelation of theoretical, methodical and practical training of students; high, but accessible level of difficulties in training sessions, fast and high-quality mastering of technique of exercises performance and mastering of the methodology of their improvement; maximum activity and independence of students during training sessions; combination of individual and collective physical culture and health activities of students; providing the educational process with sufficient quantity and quality of technical equipment and sports facilities; extensive use of innovative technologies of physical education.

The main tasks of authors' technology are: to increase the amount of physical activity in order to promote health, improve well-being, mood of students, enhance their mental and physical working capacity; to increase the level of physical fitness of students in order to ensure the effectiveness of their educational activities and improve the quality of life.

The authors' technology combines a set of components of a holistic pedagogical process – from goals to the end result – and focuses on the personality of the future professionals who has competencies and a high level of skills in health and fitness activities and sports. The authors' technology was based on the theory and methods of physical education, the theory of training of physical culture specialists, as well as the idea of integrating all components of a holistic system.

The authors' technology was introduced into the educational process of university students in four stages. At the first stage (adaptive, the 1st year of study) the solution of the following fundamental pedagogical tasks is provided: adaptation to the educational process (intensive mental activity) at HEI and

activation of the students' mental processes speed by means of physical education; developing students' stable interest, motives, positive attitude and need for motor (physical) activity; an increase in the general level of physical fitness, the development of physical abilities, reserve functional capabilities of the body, health improvement, promotion of comprehensive development; formation of knowledge on a healthy lifestyle and involvement in independent physical exercises, active leisure; mastering the skills and abilities of life safety in the field of physical culture and sports. At the second stage (achievement of comprehensive development, the 2nd year of study) the solution of the following pedagogical tasks is provided: developing students' socially significant qualities; the use of various forms of physical education and mastering health programs; mastering innovative technologies of physical education. At the third stage (forming the need for a healthy lifestyle, the 3rd-4th years of study) the solution of the following pedagogical tasks is provided: harmonious development of an organism and a significant increase in physical performance; developing students' stable need for physical self-improvement, self-cognition, and self-assessment; defining a system of physical exercises or a sport to create a system of personal physical improvement; the acquisition of skills and abilities to conduct independent training and health-improving activities, dosing of physical activity; gaining experience to use physical culture and sports activities to get professional and life skills and qualities; mastering the methodology of organizing and conducting mass sporting events and fitness and health activities in the future professional activity. At this stage, the principle of professional orientation and designing of the educational material content were carried out to use in future professional activities, taking into account the chosen specialty.

The students of the control groups were training according to the "Physical Education" curriculum traditional for HEI of Ukraine.

The effectiveness of the authors' technology was assessed by the following indicators: the amount of students' physical activity; the dynamics of students' physical fitness during four years of studying at HEI. The amount of the students' physical activity while studying at the university was investigated by an interview methods in order to determine the time devoted to physical activity during the week activities (physical education classes, independent classes, sports sections, morning exercises, sports events, other types of physical activity). The level of students' physical fitness was assessed by the following tests: males – the 3000 m and 100 m run, long standing jumps, push-ups, pull-ups, sit-ups in 1 min, 4 x 9 m shuttle run, seated forward bend, and females – the 2000 m and 100 m run, long standing jumps, push-ups, bent arm hang, sit-ups in 1 min, 4 x 9 m shuttle run, seated forward bend.

Research methods included theoretical (the method of conceptual and comparative analyses which compared the existing theoretical approaches to studying the current state of the physical education system of the students of the Ukrainian HEI, analyzed educational, methodical literature and many years of teaching experience); empirical (pedagogical

observations, questionnaires and surveys, physical fitness testing); the pedagogical experiment was conducted to check the effectiveness of authors' technology of increasing physical activity of university students; statistical data processing methods were used to process research results and display them in tabular forms.

## RESULTS

The research showed that only purposeful methodical work on the formation of motivational and value-based attitude to the physical education process and the means of physical culture and sports contributes to the activation of physical activity of university students. Experimental data show that the traditional system of physical education is not able to cause significant changes in the structure of the students' budget of time in favor of physical activity. The comparison of the time spent by the students of control and experimental groups on educational and independent physical exercises, sports training, mass sporting events, fitness and health activities, morning hygienic gymnastics, etc. indicates a huge gap between groups (Table 1). The students of experimental groups miss fewer physical education classes, attend classes in sections and groups of physical training more often, pay more attention to the implementation of morning hygienic gymnastics and sports events held at the university. Accordingly, such differences in the time spent on physical activity encourage students of experimental groups to successful physical culture and sports activities and a positive result in physical education.

The analysis of students' physical fitness indicators obtained in the process of experiment convincingly showed the high efficiency of the authors' technology. In all eight tests on physical fitness, male students of the EG significantly improved their performance (Table 2). The most significant results were shown in the 3000 m run, push-ups, pull-ups,

sit-ups in 1 min, seated forward bend ( $p < 0.001$ ), 100 m run, long standing jumps, 4 x 9 m shuttle run ( $p < 0.05$ ). In the CI, male students improved the results in five tests, namely: sit-ups in 1 min, seated forward bend ( $p < 0.01$ ), 3000 m run, push-ups, and pull-ups ( $p < 0.05$ ), but the average indicators were significantly lower.

Female students from the EG also improved their performance significantly in all tests. The best results were achieved in the 2000 m run, push-ups, bent arm hang, sit-ups in 1 min ( $p < 0.001$ ), seated forward bend ( $p < 0.01$ ), 100 m run, long standing jumps, and 4 x 9 m shuttle run ( $p < 0.05$ ). In the CG, female students showed a significant improvement only in three tests, namely: sit-ups in 1 min ( $p < 0.01$ ), 2000 m run, and bent arm hang ( $p < 0.05$ ). In general, the performance of female students in the CG was significantly lower (Table 3).

## DISCUSSION

An effective system of physical education must meet the following requirements: a) to ensure targeted physical activity of all segments of the population and to promote the improvement of physical fitness, health, and disease prevention on this basis; b) to guarantee the availability and quality of health-improving services; c) to form the necessary human, financial, and material and technical support, their rational use [12, 13].

Therefore, the program requirements for physical education should take into account the corresponding minimum level of compulsory physical education for university students, and the purpose of the "Physical Education" discipline at HEI is to consistently form the physical culture of the individual. In addition, the main criteria for the physical education effectiveness of a HEI graduate, one's mastery of health competencies, the necessary state of health, physical development level, and preparedness for life should be defined. Instead, many authors [14, 15] show in their research the dynamics of growth in the

**Table 1.** Weekly physical activity of university students as a result of the introduction of the authors' technology into the educational process (in h:min, %)

The types of physical activity	Groups	The year of study								Average data	
		1st		2nd		3rd		4th		time	%
		time	%	time	%	time	%	time	%		
Scheduled classes	EG	2:51	1.70	2:54	1.73	2:49	1.68	2:46	1.65	2:50	1.69
	CG	2:45	1.64	2:39	1.58	2:31	1.50	2:14	1.33	2:33	1.52
Independent extracurricular classes	EG	2:16	1.35	2:43	1.62	3:32	2.11	3:36	2.15	2:57	1.76
	CG	2:04	1.23	2:18	1.37	2:06	1.25	3:47	2.26	2:44	1.63
Training in sections, groups	EG	3:21	2.00	4:07	2.45	3:44	2.23	3:41	2.20	3:54	2.33
	CG	2:34	1.53	2:48	1.67	2:30	1.49	1:52	1.12	2:16	1.35
Morning exercises	EG	0:54	0.54	1:51	1.11	1:48	1.08	1:43	1.03	1:26	0.86
	CG	0:43	0.43	0:56	0.56	1:13	0.73	0:52	0.52	0:56	0.56
Sports events	EG	0:21	0.21	0:29	0.29	0:35	0.35	0:31	0.31	0:29	0.29
	CG	0:18	0.18	0:15	0.15	0:18	0.18	0:14	0.14	0:17	0.17
Fast walking	EG	2:26	1.45	2:19	1.38	2:24	1.43	2:37	1.56	2:27	1.46
	CG	2:38	1.57	2:47	1.66	2:53	1.72	3:09	1.88	2:52	1.71
Other physical activity	EG	1:15	0.75	1:38	0.98	1:47	1.07	1:56	1.15	1:39	0.99
	CG	1:27	0.87	1:46	1.06	2:03	1.22	2:18	1.37	1:54	1.33
In total	EG	13:24	7.98	16:01	9.54	16:39	9.91	16:50	10.02	15:46	9.36
	CG	12:29	7.43	13:29	8.03	13:34	8.08	14:26	8.60	13:32	8.06

**Table 2.** The dynamics of the male students' physical fitness indicators before and after the experiment (n=197), Mean±SD

Tests	Groups	Before the experiment	After the experiment	Changes in 4 years	Significance value	
					t	p
3000 m run (min, s)	EG	13.59.1±1.53	12.41.4±1.61	1.17.7	2.78	<0.001
	CG	13.57.3±2.36	13.39.2±2.13	18.1	2.19	<0.05
100 m run (s)	EG	14.41±0.67	13.72±0.92	0.69	1.23	<0.05
	CG	14.37±0.56	14.24±0.69	0.13	1.06	>0.05
Long standing jump (cm)	EG	216.37±19.72	229.53±18.14	13.16	2.35	<0.05
	CG	215.19±18.18	217.21±17.57	2.02	1.19	>0.05
Push-ups (reps)	EG	29.68±7.43	43.93±6.48	14.25	2.14	<0.001
	CG	30.02±6.63	35.76±7.35	5.74	1.96	<0.05
Pull-ups (reps)	EG	7.83±3.19	13.89±4.21	6.06	1.87	<0.001
	CG	7.93±3.41	10.24±3.38	2.31	1.96	<0.05
Sit-ups (reps)	EG	32.46±5.35	52.01±7.59	19.55	2.49	<0.001
	CG	33.09±6.22	44.71±7.76	11.62	2.08	<0.01
4 x 9 m shuttle run (s)	EG	10.13±0.61	9.03±0.79	1.1	0.93	<0.05
	CG	9.93 ± 0.78	9.45 ± 0.82	0.48	1.43	> 0.05
Seated forward bend (cm)	EG	9.53 ± 6.21	17.74 ± 5.37	8.21	2.73	< 0.001
	CG	9.48 ± 6.37	13.43 ± 6.28	3.95	1.94	< 0.01

Note: Mean: arithmetical average; SD: standard deviation; t: t-test value, p: the significance of the difference between the indicators of studied groups before and after the experiment

**Table 3.** The dynamics of the female students' physical fitness indicators before and after the experiment (n=172), Mean±SD

Tests	Groups	Before the experiment	After the experiment	Changes in 4 years	Significance value	
					t	p
2000 m run (min, s)	EG	11.43.1±1.34	10.19.4±1.23	1.23.7	2.72	<0.001
	CG	11.37.1±1.06	11.19.3±1.94	17.8	2.64	<0.05
100 m run (s)	EG	18.34±1.27	17.04±1.48	1.3	2.01	<0.05
	CG	17.87±0.36	17.91±0.63	-0.04	1.24	>0.05
Long standing jump (cm)	EG	165.65±7.80	177.43±7.98	11.78	2.16	<0.05
	CG	166.19±6.08	171.23±7.52	5.04	1.97	>0.05
Push-ups (reps)	EG	9.14±3.75	18.02±4.26	8.08	2.17	<0.001
	CG	9.78±3.43	12.31±3.23	2.53	1.94	>0.05
Bent arm hang (s)	EG	6.94±6.74	15.83±5.16	8.89	1.76	<0.001
	CG	7.21±6.43	9.63±4.78	2.42	1.82	<0.05
Sit-ups (reps)	EG	27.49±4.47	43.62±3.79	16.13	1.98	<0.001
	CG	28.45±5.12	36.84±4.03	8.39	2.14	<0.01
4 x 9 m shuttle run (s)	EG	11.04±0.81	10.42±0.63	0.62	1.79	<0.05
	CG	10.95±0.67	10.81±0.76	0.14	1.83	>0.05
Seated forward bend (cm)	EG	13.62±2.84	18.16±3.64	4.54	2.18	<0.01
	CG	12.86±3.63	14.58±3.98	1.72	2.03	>0.05

Note: Mean: arithmetical average; SD: standard deviation; t: t-test value, p: the significance of the difference between the indicators of studied groups before and after the experiment

number of students who are assigned to a special medical group after a medical examination at a HEI. There are also problems in preparing students of the main educational department to take tests on physical training, insufficient material and technical support of physical exercises and sports.

With the entry of Ukraine into the Bologna process, new problems arose in the system of physical education of students, and the destruction of the traditional process of physical education began. Not understanding the principles of the Bologna process, not deciding on the content of subjects and technology of their structuring, many HEI principles of various ranks required departments of physical education to develop a credit-modular system of the educational process in physical education in accordance with European Credit Transfer Systems (ECTS). Physical education and where its

place will be in the case of Ukraine's entry into the educational and scientific space of Europe has become the subject of discussion. Currently, physical education falls into line with special disciplines, which violate the principles of regularity, consistency, continuity of exercises. It should also be noted that none of the special disciplines is studied at the HEI of Ukraine for four years or more. Undoubtedly, the developed system of studying should be integrated into the European educational space. Such a system, which began to be developed by many departments of physical education at HEI of Ukraine, does not exist in Europe. In Ukraine, attempts to implement ECTS requirements in the discipline of "Physical Education" have been made. The study of the experience of European countries, as well as the analysis of leading European publications in the field of education and upbringing, showed that physical

education is not included in the curricula of universities, but is an independent work of students. Students take care of their own physical development, their own health, and proper level of performance [16, 17, 18].

Currently, Ukraine has a traditional training system for students at HEI, where physical education is an integral part of professional training. Transferring students to independent physical education classes is unjustified and premature today. It is substantiated by a low level of consciousness of students and careless attitude to their own health; the lack of criteria for assessing the health of professionals who are applying for a job; the material and technical base is not able to provide individual desires of students to exercise in their spare time; very low physical fitness of most students and their insufficient physical development; 5.7 to 20.0% of students having disabilities and diseases that require classes in special rehabilitation techniques under the guidance of a teacher or methodologist of physical therapy; retraining of teaching staff needed, change of the curriculum and staff training at physical education universities, institutes, and faculties of physical education.

The prospects for a radical change in the system of physical education of students should be associated with the introduction of healthy lifestyle technologies, ensuring good health, physical, mental, social, emotional, and spiritual well-being of students. Depending on the target setting, organizational forms, means, and types of physical activity in the system of physical education, the following main groups of physical education can be recommended: active games, competitive sports, recreational and health-promoting sports, health-improving motor activity, professionally-oriented motor activity, everyday motor activity.

The results of the experiment show that the implemented authors' technology in the educational process of university students, contributes to improving the quality of the students' physical education. The authors' technology requires the teacher to adhere to the principle of mutual respect and cooperation by the basic principle of assessing the physical fitness of students. A teacher who does not use encouragement, praise, does not want to understand a student who cannot meet the standard for physical testing, will ruin the student's desire to exercise. Unsatisfactory grades on physical fitness should not degrade the students' dignity. Testing indicators should be used in three aspects in order to 1) determine the level of physical fitness of students and evaluate it; 2) optimize physical activity in physical education classes and adjust the use of the means of physical qualities development; 3) activate students' motivation for physical improvement and independent physical exercises.

## CONCLUSIONS

The checking of the effectiveness of authors' technology of increasing physical activity of university students showed its greater effectiveness in comparison to the traditional program of physical education at HEI. The students (both males and females) of the experimental groups were recorded to have significantly ( $p < 0.001$ ) better indicators than the control

groups, according to the following criteria: the amount of students' physical activity while studying at the university (scheduled classes, independent classes, sports sections, morning exercises, etc.); the level of physical fitness indicators. A high level of physical activity of students will contribute to strengthening their health and improving the efficiency of their future professional activities.

Prospects for further research are aimed at studying the students' motivation for physical improvement and independent physical exercises.

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#### Conflict of interest:

The Authors declare no conflict of interest

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# Analysis of Health and Physical Fitness Indicators of Modern Youth

## Analiza wskaźników zdrowia i sprawności fizycznej współczesnej młodzieży

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### SUMMARY

**Aim:** To research the level and dynamics of indicators of students' physical health and physical fitness in higher educational institutions at the present stage.

**Materials and Methods:** The research involved 106 students: 57 male students and 49 female students. The research of the level of physical health was conducted according to the method of H.L. Apanasenko, which involves determining the amount of points for each of the 5 indices. The level of physical fitness was assessed by the results of 7 physical exercises.

**Results:** It has been found that students' health indicators do not improve significantly in the process of their education. Most indices correspond to a level below the average. According to most physical fitness tests, both male and female students are rated "satisfactory" and "unsatisfactory". Physical qualities such as endurance and flexibility have the worst level of development.

**Conclusions:** The low level of health and physical fitness of students confirms the lack of effectiveness of the existing system of physical education in higher educational institutions. Underestimating the role of physical education in improving the health of today's youth can result in a deterioration of the quality of life of students themselves in the future, as well as to a deterioration in their productivity and, consequently, lower economic development of the country.

**Key words:** health, physical fitness, youth, physical education

**Słowa kluczowe:** zdrowie, sprawność fizyczna, młodzież, wychowanie fizyczne

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### INTRODUCTION

In the current conditions of Ukraine's integration into the European higher education system, the strategic task of reforming higher education in Ukraine foresees the transition to student-centred education, transformation of quantitative indicators of educational services into qualitative, which involves reviewing the content of higher education and filling it with the latest material, introduction of modern learning technologies, ensuring mobility, employment and competitiveness of specialists [1, 2]. In the light of Ukraine's accession to the European Educational Society, the issues of student physical education and sports are newly considered as a component of shaping the professional health of future graduates, who must ensure competitiveness in the world

labour market [3, 4]. There is an urgent problem in increasing students' interest in the quality of education, encouraging each student to regular physical exercises and sports, the formation of students' motivation for self-training in the process of learning and future life-sustaining activities [5-7].

Physical education is a component of education and upbringing, pedagogical process, academic subject (discipline), aimed at mastering knowledge, skills and abilities to manage physical development, types of motor activity to teach and educate the individual in the spirit of responsible attitude to their own health and health of others [8-10]. According to the scientists [11-13], physical education in the higher educational institution (HEI) should be a reliable basis for a high level of mental working capacity and intellectual

development of students in the learning process, involving them in regular exercise and sports, creating the need for physical development and improvement to ensure health and professional longevity.

However, unfortunately, according to many scientists [14, 15], the situation with the state of health and physical fitness of students of HEIs of Ukraine is critical at the present stage. About 90% of students have various health problems, more than 50% are characterised by unsatisfactory level of physical fitness [16, 17]. Moreover, the health of the population of Ukraine, including students, has deteriorated significantly due to the coronavirus pandemic and the forced reduction in physical activities [18-21]. Therefore, the research of the level and dynamics of health and physical fitness indicators of students in HEIs of Ukraine at the present stage in order to find and justify effective ways to solve this problem are relevant and timely.

### AIM

The aim is to research the level and dynamics of indicators of students' physical health and physical fitness in higher educational institutions at the present stage.

### MATERIALS AND METHODS

The research was conducted in 2019-2021 at the Khmelnytskyi National University (Khmelnytskyi, Ukraine). The research involved 106 students who entered Faculty of Humanities and Education and Faculty of Information Technologies in 2019: 57 male students and 49 female students. The research was conducted during the first and the second instructional years (1-4 semesters).

The research of the level of physical health (LPH) was conducted according to the method of H.L. Apanasenko, which involves determining the amount of points for each of the 5 indicators (indices): body mass index (BMI), Life index (LI), strength index (SI), Robinson index (RI), time to restore

heart rate to baseline after standard exercise (20 squats for 30 seconds). The LPH was assessed as follows: if the sum of the student's points, scored on 5 indices, was 16 or more points, the LPH was rated as "high"; at 12-15 points the LPH was rated as "above average"; at 7-11 points – as "average"; at 4-6 points – as "below average"; at 3 and less – as "low" [22]. The level of physical fitness (PF) of students was assessed by the results of 7 physical exercises, which allowed to assess the development of various physical qualities: speed (100 m run), strength qualities (pull-ups on the crossbar – men, push-ups – women, torso lifting, standing long jump), endurance (3000 m run – men, 2000 m run – women), agility (4x9 m shuttle run), flexibility (torso leaning forward from the sitting position).

Research methods: theoretical analysis and generalization of data from scientific and methodological literature; pedagogical observation; testing of indicators of physical fitness, medical and biological methods; methods of mathematical statistics. During the research, the authenticity of the difference between the studied indicators of students employing Student's t-test was determined. The significance for all statistical tests was set at  $p < 0.05$ . All statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS) software, version 21. The research has been complied with all the relevant national regulations and institutional policies, and has followed the tenets of the World Medical Association Declaration of Helsinki. The research was carried out according to the requirements of the Code of Ethics of Khmelnytskyi National University (No.11 dated 22.07.2019). Prior consent to participate in the research was obtained from all the participants.

### RESULTS

The results of the analysis of the level and dynamics of physical health indicators of students (men and women) for the period of study in the HEI during the first and second instructional years are given in Table 1. The analysis of

**Table 1.** Dynamics of the indicators of physical health of students (male and female) during the research period (n=106, Mean±SD)

Researched indicators	Stages of the research				p1-p4
	first	second	third	fourth	
	Male students (n=57)				
BMI, kg/m <sup>2</sup>	22.9±0.19	23.2±0.20	23.3±0.21	23.4±0.22	p>0.05
LI, ml/kg	55.4±0.97	55.5±1.02	55.3±1.03	55.2±1.01	p>0.05
SI, %	57.2±1.07	56.9±1.11	56.7±1.09	56.8±1.06	p>0.05
RI, c.u.	89.6±1.18	89.5±1.16	89.8±1.15	89.9±1.17	p>0.05
Time to restore heart rate, s	135.2±2.75	134.8±2.78	134.9±2.80	135.8±2.77	p>0.05
LPH, points	1.96±0.47	2.03±0.45	1.98±0.48	1.95±0.49	p>0.05
	Female students (n=49)				
BMI, kg/m <sup>2</sup>	21.3±0.24	21.5±0.25	21.8±0.26	21.9±0.26	p>0.05
LI, ml/kg	46.2±1.08	46.1±1.12	45.9±1.09	45.8±1.10	p>0.05
SI, %	39.1±1.03	39.0±0.99	38.8±1.01	38.5±0.97	p>0.05
RI, c.u.	87.5±1.21	87.5±1.20	87.7±1.18	87.8±1.17	p>0.05
Time to restore heart rate, s	138.4±3.01	138.6±2.99	138.9±2.95	139.2±2.93	p>0.05
LPH, points	2.02±0.51	2.05±0.49	1.99±0.50	1.97±0.52	p>0.05

Note: Mean – arithmetical average; SD – standard deviation; Stages of the research: first – 1-st semester, second – 2-nd semester, third – 3-rd semester, fourth – 4-th semester; p1-p4 – the significance of the difference between the students' indicators at the first and fourth stages of the research, determined by Student's t-test

BMI showed that both male and female students tend to its worsening i.e. the difference between the initial and final data is 0.5 and 0.6 kg/m<sup>2</sup>, respectively. However, BMI in both groups of students has not changed significantly during the research ( $p>0.05$ ). At the same time, BMI corresponds to the age norm and the average level for both male and female students, at all stages of the research.

The analysis of the dynamics of LI shows that both male and female students tend to its decrease, but it did not change significantly during the research ( $p>0.05$ ). The difference between the indicators of the initial and last stages of the research made 0.2 ml/kg in men and 0.4 ml/kg in women. This indicates that the functional capabilities of the respiratory system in students are weakened in the process of their learning at HEI. LI in both male and female students was assessed as “below average” at all stages of the research. The analysis of SI indicators, which was determined by the ratio of the dynamometry of the stronger hand to body weight showed that its value did not change significantly ( $p>0.05$ ) in students of both sexes during their learning process. Moreover, the level of SI was assessed as “low” in both men and women at all stages of the research. This confirms the conclusions of many authors that physical education does not sufficiently affect the development of the muscular system of students in modern HEIs. The dynamics of RI is characterized by a trend similar to previous indices i.e. the lack of significant changes during the learning process ( $p>0.05$ ) and the gradual deterioration of the functionality of the cardiovascular system in students, both male and female. RI deteriorated by 0.3 c.u. and corresponded to the average level at all stages of the research. The analysis of the dynamics of the time of recovery of heart rate to baseline showed that it did not change significantly in students of both sexes during the research ( $p>0.05$ ), although there was deterioration in male students by 0.6 seconds and in female students by 0.8 seconds. The level of functional state of the body, which was assessed by this index, was characterised as “below average” in both male and female students.

The research of H.L. Apanasenko [22] determined that there is a safe LPH – according to the express method it is 12 points. The author claims that there are almost no diseases, or even risk factors for chronic physical diseases above this level. The analysis of students’ LPH showed that it did not change significantly during the research period in both male and female students ( $p>0.05$ ). At the same time, there is some

deterioration in the general state of health, the difference between the indicators of the first and fourth stages of the research made 0.1 points in male and 0.5 points in female students. The general state of health in both male and female students was rated as “low” at all stages of the research. The ratio of students with different LPH is presented in Table 2.

It was found that the majority of students (men and women) have low and below average LPH at all stages of the research: 56.1% and 31.6% of students with low and below average LPH, respectively were identified among men at the beginning of the research; this ration made 55.1% and 26.5% among women. The situation deteriorated somewhat during the research period: the number of students with low LPH increased by 5.3% among men and by 8.1% among women, and their number with average and above average LPH decreased.

The results of the analysis of the level and dynamics of indicators of physical fitness of students (men and women) for the period of their study in HEI are given in Table 3. In general, most of the tested characteristics show an improvement in the results of students of both sexes, but no significant difference between the initial and final results of students was found ( $p>0.05$ ). In addition, the level of development of physical qualities is mostly assessed as “satisfactory”. Thus, the analysis of the level of development of speed qualities of students showed that the results of 100 m run improved by 0.2 seconds in male students, and by 0.1 seconds in female students. The level of development of students’ speed qualities was assessed as “satisfactory” at all stages of the research.

The analysis of the level of development of strength qualities of male students showed that the results in pull-ups improved by 0.6 times and female students revealed better results in push-ups by 0.7 times during the research period. The level of development of strength qualities is assessed as “satisfactory” in both men and women at all stages of the research. Negative dynamics was found in the results of male students in the 3000 m run and female students in the 2000 m run. Thus, male students’ results deteriorated by 19 seconds (from 14 minutes 28 seconds at the beginning of the research to 14 minutes 47 seconds at the end of the research) during the research period; in female students – by 18 seconds (from 13 minutes 17 seconds at the beginning of the research to 13 minutes 35 seconds at the end of the research). The level of endurance development in students of both sexes is assessed as “unsatisfactory”. The results of the 4x9 m shuttle run for

**Table 2.** The ratio of students with different LPH at the beginning and the end of the research (n=106, number of people / %)

Stages of the research	LPH				
	High	Above average	Average	Below average	Low
Male students (n=57)					
Beginning	–	2/3.5	5/8.8	18/31.6	32/56.1
End	–	2/3.5	4/7.0	16/28.1	35/61.4
Female students (n=49)					
Beginning	–	3/6.1	6/12.2	13/26.5	27/55.1
End	–	2/4.2	5/10.2	11/22.4	31/63.2

**Table 3.** Dynamics of the indicators of physical fitness of students (male and female) during the research period (n=106, Mean±SD)

Exercises	Stages of the research				p1-p4
	first	second	third	fourth	
Male students (n=57)					
100 m run, s	14.7±0.11	14.5±0.10	14.4±0.09	14.5±0.09	p>0.05
Pull-ups, times	9.6±0.54	9.9±0.57	10.1±0.58	10.2±0.56	p>0.05
3000 m run, s	868.3±11.73	871.5±11.87	879.7±11.93	886.9±12.04	p>0.05
4x9 m shuttle run, s	9.7±0.48	9.5±0.46	9.4±0.45	9.3±0.46	p>0.05
Torso lifting, times	37.8±0.96	38.1±0.94	39.5±0.93	40.3±0.94	p>0.05
Standing long jump, cm	224.1±2.58	226.3±2.59	226.9±2.60	227.1±2.58	p>0.05
Torso leaning, cm	7.4±0.85	7.4±0.86	7.3±0.82	7.2±0.80	p>0.05
Female students (n=49)					
100 m run, s	17.4±0.10	17.2±0.09	17.2±0.09	17.3±0.10	p>0.05
Push-ups, times	14.1±0.58	14.5±0.61	14.6±0.59	14.8±0.59	p>0.05
2000 m run, s	797.2±10.14	802.3±10.24	809.3±10.31	814.5±10.37	p>0.05
4x9 m shuttle run, s	11.5±0.55	11.4±0.57	11.4±0.59	11.3±0.58	p>0.05
Torso lifting, times	35.2±1.01	36.2±0.99	37.0±0.95	37.4±0.97	p>0.05
Standing long jump, cm	173.4±2.40	175.1±2.44	175.5±2.42	175.6±2.39	p>0.05
Torso leaning, cm	13.4±0.77	13.7±0.76	13.8±0.75	14.2±0.73	p>0.05

Note: Mean – arithmetical average; SD – standard deviation; Stages of the research: first – 1-st semester, second – 2-nd semester, third – 3-rd semester, fourth – 4-th semester; p1-p4 – the significance of the difference between the students' indicators at the first and fourth stages of the research, determined by Student's t-test

students of both sexes improved during the research period, but the level of development of agility of both male and female students is assessed as “satisfactory”. Both male and female students developed indicators of abdominal muscle progress during the research period in terms of torso lifting for 1 minute: the difference between the results at the beginning and end of the research is 2.5 times in men, and 2.2 times in women. The level of strength qualities of students of both sexes in this exercise at the end of the research is assessed as “good”. The results of the standing long jump of students also tend to increase in the process of their study in the HEI. They improved by 3 cm in men and by 2.2 cm in women. The level of speed and strength qualities of students is assessed as “satisfactory”. Insufficient level of flexibility was found in students of both sexes. Thus, the analysis of the results of torso leaning forward from the sitting position showed that they deteriorated by 0.2 cm in male students and improved by 0.8 cm in female students during the research period. Herewith, flexibility indicators for male students are assessed as “unsatisfactory” and as “satisfactory” for female students at all stages of the research.

## DISCUSSION

Modernization of higher education in Ukraine is aimed at updating the principles, content and approaches to specialists' training, reorientation of the educational process to achieve integrated results (competencies) [6, 23]. It is no coincidence that among the promising tasks of the National Strategy for Educational Development the following became especially important: updating the goals and content of education on the basis of competency building approach and personal orientation, taking into account world experience and principles of sustainable development; restructuring of the educational process on the basis of developmental pedagogy; building an

effective system of national education on the basis of universal, multicultural, civic values, ensuring physical, moral and spiritual, cultural development of a human being, formation of socially mature creative personality, preparing young people for conscious choice of living environment; providing systematic improvement of the quality of education on an innovative basis, modern psychological and pedagogical as well as scientific and methodological support of the educational process [16, 24]. The higher education system is inextricably linked to other social systems, namely: economics, politics, social sphere, etc. The development of personality, training of labour potential of the country, economic development, development of the social sphere and social development in general which together determines the future of the mankind depends on the application of conceptual principles in education. However, the critically low level of physical fitness and health of modern student youth is one of the major problems of today, which does not allow to fully achieve integrated results while studying in the HEI. This is evidenced by the findings of many scientists [2, 4, 17] stating that there is a worrying situation over the past decade in Ukraine: the health and physical fitness of student youth has deteriorated sharply. The analysis of the literature allowed to determine the main reasons for the decline in health and physical fitness of students: devaluation of the social prestige of a healthy lifestyle, physical culture and sports; underestimation of the social, health promoting and educational role of physical education and sports in HEI; low level of physical condition of senior high school students and graduates; reduction of students' interest in the traditional form of organization of physical education training sessions; the focus of the educational process on physical education on students' compliance with examining standards; lack of individual approach and the principle of differentiation in the process of physical education; conditions of study in HEI,

which are accompanied by a decrease in motor activity; bad habits and others [3, 8, 19].

The results of our research confirm the conclusions of many scientists on the low level of health and physical fitness of modern student youth. Our research failed to reveal students with a high LPH, more than 80 % of students have a low and below average LPH. Most students are characterised by a satisfactory and unsatisfactory level of physical qualities development at the end of the research. All this underlines the insufficient effectiveness of the existing system of physical education in HEIs in terms of promoting health, improving students' physical fitness, the formation of motivation for regular exercise and sports.

## CONCLUSIONS

It has been found that students' health indicators do not improve significantly in the process of their higher education. Most indices correspond to a level below the average. At the same time, the number of students with low levels of physical health increased during the research by 5.3% among male students and 8.1% among female ones. According to most physical fitness tests, both male and female students are rated "satisfactory" and "unsatisfactory". Physical qualities such as endurance and flexibility have the worst level of development.

The low level of health and physical fitness of students, which was identified in the course of our research, confirms the findings of many previous studies on the lack of effectiveness of the existing system of physical education in higher educational institutions and the need to improve it. Health directly affects the productivity of future professionals, the country's economy, the moral climate in society, reflects the way and quality of life in the country. The health of the generation to come greatly depends on the health of today's students. Underestimating the role of physical education in improving the health of today's student youth can result in a deterioration of the quality of life of students themselves in the future, as well as to a deterioration in their productivity and, consequently, lower economic development of the country.

Prospects for further research are to justify effective ways to improve the level of physical fitness and health of modern youth.

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The Authors declare no conflict of interest

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# Assessment of Compliance with Healthy Lifestyle Standards by the Instructional Staff of Higher Educational Institutions

## Ocena przestrzegania zaleceń zdrowego stylu życia przez kadre dydaktyczną szkół wyższych

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### SUMMARY

**Aim:** To assess the quality of compliance with the standards of a healthy lifestyle by instructors of higher educational institutions with specific learning environment and their attitude to exercise.

**Materials and Methods:** To achieve the aim of the research, we conducted a survey of instructors (n=126) of different age groups according to the questionnaire developed by the authors. The questionnaire is designed to investigate the current state of physical training with instructional staff; to clarify the issues of instructors' healthy lifestyle; to study ways to improve their physical fitness.

**Results:** It was found that only 10.3% of instructors regularly exercise in the morning; 85.7% get to the place of service by public transport or by car and only 14.3% go on foot. On weekends, 41.3% of instructors prefer passive types of motor activity and recreation; more than 50% smoke, in addition, 30.9% smoke one pack or more a day. On top of that, 46.8% of instructors do not engage in physical training at all; 50.9% of instructors answered that they attend training sessions in order to prepare for the test.

**Conclusions:** It was found that the majority of instructors (67.1%) rarely or almost never follow the standards of a healthy lifestyle. Insufficient efficiency of the current system of physical training of instructional staff was identified and the reasons for insufficient level of physical fitness, health of instructors and systematic absence from physical training sessions were revealed.

**Key words:** healthy lifestyle, health, physical training, instructors

**Słowa kluczowe:** zdrowy styl życia, zdrowie, trening fizyczny, instruktorzy

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### INTRODUCTION

The scientific studies show that more than 50% of human health is determined by living conditions and lifestyle, i.e. most of it depends on the proper organization of motor activity [1, 2]. Motor activity is an integral part of everyone's life. Organized motor activity contributes to a healthy lifestyle, which, in turn, has a positive effect on the general level of well-being; prevention of non-communicable diseases; reduction of the impact of bad habits on the body, numerous antisocial manifestations and depressions [3, 4].

These are well-known facts, but, unfortunately, most people do not follow the standards of a healthy lifestyle. Today, the motor activity of both children and adults has sharply decreased in the conditions of active introduction

of computer technologies in all spheres of human activities. As a result, the percentage of people with impaired health has increased. Quarantine restrictions caused by the global Covid-19 pandemic are exacerbating this negative trend in health status of the population [5].

The works of many scientists [6, 7] note a deterioration of the state of health and the level of physical fitness of the population of Ukraine in recent years under conditions of social, economic and political instability: the rate of depopulation Ukraine ranks 2<sup>nd</sup> in the world, 1-2<sup>nd</sup> in Europe by mortality from cardiovascular diseases; the average life expectancy of men in Ukraine is 10-12 years lower than in the European Union; more than 70% of the adult male population have low and below average levels of physical health. The probability

of death of men of working age is 38.4%, which is one of the worst rates among civilized countries.

Law enforcement officers are no exception, especially the instructional staff of higher educational institutions of Ukraine with specific learning environment (HEI SLE), whose professional activities are characterized by a significant reduction in physical load and motor activity [8, 9, 10]. Instructional activities, which are accompanied by many negative factors, take a long time, and over time, the negative factors result in a significant reduction in mental and physical working capacity, deteriorating instructors' health.

According to many scientists [11-13], one of the ways to solve this problem is to improve physical training (PT) of the instructional staff in the HEIs SLE. However, the analysis of the regulatory documents on the organization of physical training of the instructional staff of HEIs SLE allowed to reveal a number of shortcomings that reduce the positive impact of PT on the working capacity and health of instructors, including: insufficient consideration of peculiarities of the service activities of the instructional staff by the governing documents; insufficiently clear organization of training sessions; inefficient use of time allotted for PT; significant percentage of absences from training sessions due to the tasks of teaching activities, orders of commanders in the hours allotted for independent training sessions on PT; giving preference to improving the performance of special PT and preparing for tests; high percentage of instructors are exempt from physical activity due to their state of health. In addition, many instructors are characterised by bad habits and lack of sustainable motivation to follow a healthy lifestyle, to independent regular exercise.

The problem of adherence to the standards of a healthy lifestyle by instructional staff is topical, as it is the high level of motor activity and physical fitness, which is the basis for promoting instructors' health, improving their mental working capacity and enhancing instructional activities.

### AIM

The aim is to assess the quality of compliance with the standards of a healthy lifestyle by instructors of higher educational institutions with specific learning environment and their attitude to exercise.

### MATERIALS AND METHODS

To achieve the aim of the research, we conducted a study that involved a survey of instructor officers (n=126) in various academic subject areas of the National Academy of Internal Affairs (NAIA). The survey was conducted in accordance with the main provisions and requirements for sociological research on the questionnaire developed by the authors. The questionnaire was assessed by the experts in this field (3 professors and 7 associate professors) and was approved by the Academic Council of NAIA (Protocol No.12 dated 28.08.2020). The questionnaire contains 13 questions making up three blocks, designed to: study the current state of the organization and conduct of PT with the instructional staff (the first block; questions through 6); clarify the issues of

instructors' observance of a healthy lifestyle and the impact of negative factors of instructional activities on the state of their health and well-being (second block; questions 7 through 11); study of ways to improve PT (third block; questions 12 through 13). The survey was conducted during 2020-2022. In addition to questionnaires, the research methods included theoretical analysis and generalization of literature, pedagogical observation and statistical methods.

The procedure for organizing the study was previously agreed with the committee on compliance with Academic Integrity and Ethics of the NAIA. The topic of the study was approved by the Academic Council of the NAIA (No.12 dated 28.08.2020). Informed consent was received from all participants who took part in this study.

### RESULTS

It was found that 46.8% of instructors do not engage in PT at all (citing a number of reasons); 26.9% of respondents attend training sessions for 1-2 hours a week; 17.5% of instructors engage in training sessions for 4 hours a week as it is scheduled; 6.4% are additionally engaged in training sessions during their personal time (Table 1). The instructors who are additionally engaged in physical training sessions beyond the scheduled 4 hours belong to the age groups up to 30 (62.5%) and 35 years (37.5%) (they are mostly members of national teams in various sports). It should be noted that the largest percentage of instructors who do not engage in PT at all belong to the age groups up to 35 and up to 40 years (33.9% and 44.1%, respectively). This confirms the findings of a number of scientists that 30-40-years-old instructors, who have insufficient indicators of physical fitness, are a "risk group" for cardiovascular disease.

The analysis of regulatory documents showed that the independent training of permanent staff must include PT sessions at least 4 hours a week during extracurricular activities. On the other hand, the service activities of instructors require performance of a large number of tasks at this time: details, preparation for the next academic classes, consultations, orders of commanders, involvement in activities to maintain public order, etc. – which are performed at the expense of time allotted for self-training. It was found that 43.6% of instructors are engaged in physical exercises one or two hours a week or less, 41.3% – are not engaged in PT, 8.7% – 4 hours a week, and only 6.4% of instructors are engaged in PT sessions independently two or three times a week (members of national teams). Most of the instructors who miss training sessions (59.6%) belong to the age groups up to 35 and 40 years.

It was found that 50.9% of instructors are engaged in PT to prepare for the test, 21.4% – to improve the appearance and well-being; 17.4% – in order to increase the level of physical fitness and promote health; 8.7% – to improve mental working capacity and enhance service activities. This shows that not all instructors consider PT as a means of improving health, mental working capacity and enhancing the indicators of their service activities.

The reasons of missing PT sessions are distributed in the following way: 70.7% of instructors noted a lack of free time

**Table 1.** The answers of instructors of the HEI SLE on the first block of the questionnaire (n=126, %)

Question	Answer options	Age groups, years					Total n=126
		30 n=21	35 n=27	40 n=32	45 n=27	> 45 n=19	
1. How many hours a week do you engage in PT?	4 hours as scheduled	18.2	9.1	9.1	27.3	36.4	17.5
	4 hours and in private	62.5	37.5	0	0	0	6.3
	1-2 hours	5.9	5.9	11.8	52.9	23.5	27
	I do not work out at all	13.6	33.9	44.1	3.4	5.1	46.8
	own answer	66.7	0	0	33.3	0	2.4
2. How many hours a week do you engage in PT individually?	4 hours as scheduled	18.2	0	0	45.5	36.4	8.7
	4 hours and in private	62.5	37.5	0	0	0	6.3
	1-2 hours or less	10.9	21.8	23.6	21.8	21.8	43.7
	I do not work out at all	15.4	23.1	36.5	19.2	5.8	41.3
	own answer	0	0	0	0	0	0
3. Why do you attend PT sessions?	to increase physical fitness and promote health	13.6	4.5	4.5	40.9	36.4	17.5
	to increase mental working capacity	0	0	0	27.3	72.7	8.7
	to improve appearance, well-being	37.0	18.5	7.4	37	0	21.4
	to prepare for the test	12.5	32.8	46.9	3.1	4.7	50.8
	own answer	0	0	0	100	0	1.6
4. Indicate the reasons why you miss PT sessions	lack of free time	16.9	21.3	22.5	27.0	12.4	70.6
	large amount of tasks	33.3	16.7	41.7	0	8.3	9.5
	fatigue after academic classes	0	10	40	20	30	7.9
	fuzzy planning	13.3	33.3	20	6.7	26.7	11.9
	lack of desire	0	0	0	0	0	0
	I do not consider it necessary	0	0	0	0	0	0
	own answer	0	0	0	0	0	0
5. Are you satisfied with your level of physical fitness?	yes	32.1	35.7	10.7	17.9	3.6	22.2
	no	12.6	17.9	29.5	22.1	17.9	75.4
	own answer	0	0	33.3	33.3	33.3	2.4
6. Are you satisfied with the state of PT organization?	yes	2.9	37.1	54.3	0	5.7	27.8
	no	22.4	16.5	12.9	29.4	18.8	67.5
	own answer	16.7	0	33.3	33.3	16.7	4.8

(due to participation in the educational process); 11.9% – fuzzy planning of PT sessions (instructors conduct academic classes with cadets during the hours for PT sessions); 9.5% miss training sessions due to a large amount of service tasks; 7.9% – due to fatigue after intellectual workload. Herewith, 75.4% of instructors stated that they were not satisfied with their own level of physical fitness for effective performance of teaching tasks; 22.2% of respondents gave a positive answer. It was also found that 67.5% of instructors are dissatisfied with the state of the organization of PT in the HEI SLE. Most instructors would like to work out on their own in their free time, as the vast majority of them are forced to skip training sessions due to scheduled academic classes with cadets and military students.

As a result of the analysis of the answers to the questions of the second block of the questionnaire (Table 2) regarding the observance of a healthy lifestyle by the instructional staff, it was found that only 10.3% of instructors regularly perform morning exercise daily (23% – sometimes and 66.7% – never); 85.7% get to the place of service by public transport or by car and only 14.3% go on foot (72.2%). On weekends and holidays, preference is given to passive types of motor activity and recreation (watching TV, working on a computer,

improving the professional level, etc.) – 41.3%; 37.3% of officers spend their free time with family and friends, and only 9.5% of officers are engaged in exercise and sports, use tempering tools, and prefer walking.

The issue of bad habits, including smoking, is very acute. It was found that more than 50% of instructors smoke, whereupon 20.6% smoke no more than half a pack of cigarettes a day, 30.9% – one pack or more a day; 43.7% of instructors answered that they do not smoke. The analysis of the answers to the last four questions showed that many instructors (67.1%) rarely or almost never use factors that contribute to maintaining and promoting health.

Irritability, depression, fatigue, headache and other symptoms due to the negative impact of factors of teaching profession at the end of the working day (week) are experienced by 88.9% of instructors (22.2% – sometimes, 51.6% – often; 15.1% – always) and only 11.1% of instructors have never had such symptoms. It is important to note that the majority of instructors, who always have similar symptoms and complaints, belong to the older age groups (40 – over 45 years, 94.7%), which indicates that the negative impact of service activities is enhancing with age and increasing the risk of various diseases.

**Table 2.** The answers of instructors of the HEI SLE on the second block of the questionnaire (n=126, %)

Question	Answer options	Age groups, years					Total n=126
		30	35	40	45	> 45	
		n=21	n=27	n=32	n=27	n=19	
7. How often do you exercise in the morning?	every day	30.8	23.1	7.7	23.1	15.4	10.3
	sometimes	27.6	20.7	24.1	10.3	17.2	23
	never	10.7	21.4	28.6	25.0	14.3	66.7
	own answer	0	0	0	0	0	0
8. How do you get to the place of service?	by public transport	16.9	27.1	33.9	15.3	6.8	46.8
	by your own car	16.3	20.4	22.4	26.5	14.3	38.9
	on foot	16.7	5.6	5.6	27.8	44.4	14.3
	own answer	0	0	0	0	0	0
9. How do you spend your free time (on weekends, holidays)?	computer games	66.7	33.3	0	0	0	4.8
	listening to music	66.7	33.3	0	0	0	2.4
	reading fiction	0	0	25.0	0	75	3.2
	watching TV	0	23.1	46.2	15.4	15.4	10.3
	communicating with family, friends	19.1	17	27.7	23.4	12.8	37.3
	raising your professional level	7.7	19.2	26.9	23.1	23.1	20.6
	exercising, tempering	33.3	25	8.3	16.7	16.7	9.5
own answer	0	33.3	26.7	40	0	11.9	
10. How often do you smoke?	no more than half a pack a day	7.7	15.4	30.8	19.2	26.9	20.6
	I do not smoke	30.9	21.8	12.7	23.6	10.9	43.7
	one pack and more a day	2.6	28.2	35.9	20.5	12.8	30.9
	own answer	16.7	0	50	16.7	16.7	4.8
11. How often do you get irritable, depressed, headache?	never	85.7	14.3	0	0	0	11.1
	sometimes	25	57.1	10.7	7.1	0	22.2
	often	3.1	12.3	36.9	26.2	21.5	51.6
	always	0	5.3	26.3	42.1	26.3	15.1
	own answer	0	0	0	0	0	0

**Table 3.** The answers of instructors of the HEI SLE on the third block of the questionnaire (n=126, %)

Question	Answer options	Age groups, years					Total n=126
		30	35	40	45	> 45	
		n=21	n=27	n=32	n=27	n=19	
12. How do PT sessions affect health and mental working capacity?	positively	16.8	21	24.4	21.8	16	94.4
	indirectly	20	20	40	20	0	4
	they do not affect	0	50	50	0	0	1.6
	negatively	0	0	0	0	0	0
	own answer	0	0	0	0	0	0
13. How is it possible to improve the physical fitness, health and mental working capacity of instructors of HEI SLE?	increase of standards on PT	0	33.3	44.4	22.2	0	7.1
	increase of requirements of commanders	25	25	50	0	0	6.3
	increase of quantity of special PT sessions	6.7	40.0	53.3	0	0	11.9
	increase of quantity of general PT sessions	16.1	14.5	14.5	30.6	24.2	49.2
	increase of quantity of systematic independent training sessions	27.6	20.7	24.1	17.2	10.3	23.1
own answer	0	33.3	0	33.3	33.3	2.4	

The study of the answers to the questions of the third block (Table 3) revealed that 94.4% of instructors believe that PT sessions have a positive effect on health, mental working capacity and efficiency of undertaking instructional activities; 1.6% of respondents believe that PT sessions do not affect the health and efficiency of undertaking instructional activities.

The respondents answered the question “How is it possible to improve the physical fitness, health and mental working capacity of instructors of HEIs SLE?” in the following manner:

“increase quantity of general PT sessions” – 49.2%; “increase of quantity of systematic independent sessions on PT and sports within the daily routine” – 23.1%; “increase of quantity of special PT sessions” – 11.9%; “increase of standards on PT” – 7.1%; “increase the requirements of commanders” – 6.3%; 2.4% of officers noted a different answer. Thus, most instructors believe that physical fitness, health and mental working capacity can be improved by using general PT activities during regular self-training sessions within the daily routine.

## DISCUSSION

The analysis of the scientific works [14-16] showed that one of the prevailing trends in the structure of modern work of instructors of HEIs SLE is its ever-increasing intellectualization and a sharp increase in requirements for quality, speed of mental and psychomotor operations. Instructors of theoretical disciplines of HEIs SLE spend most of their working time indoors in a forced working position, in conditions of insufficient motor activity. In addition, bad habits and lack of time for PT sessions do not provide the necessary level of physical fitness and health of instructors.

Low motor activity, as the main negative factor of instructional activities, results in various disorders of body systems, metabolism, overweight, which adversely affects instructors' health and causes various diseases with age [17, 18]. Instead, the optimal level of motor activity is the amount and content of motor activity that should meet the natural human need in motor performance to improve their health, prevent non-communicable diseases and improve professional working capacity, as well as positively affect the intellectual component of human life [19, 20].

The studies [21, 22] have shown that the indicators of service activities efficiency are reduced under the influence of adverse factors by 20% in law enforcement officers who have a high level of physical fitness, and by 40-50% in those who have a low level of physical fitness. High levels of physical fitness reduce the degree of fatigue and delay its occurrence date, allow to increase the body's resistance to specific adverse effects [23, 24]. The research of the scientists [25, 26] revealed that regular use of PT options promote the effective development of motor skills, while having a positive effect on the basic systems of the body and the emotional state of law enforcement officers. In addition, PT sessions contribute to the improvement of psychophysiological indicators of law enforcement officers (memory, attention, thinking) and the formation of moral and volitional qualities [27, 28].

In the process of the questionnaire, we studied the opinion and attitude of instructors on their compliance with the standards of a healthy lifestyle, on the effectiveness of PT in HEIs SLE. The results of the survey revealed the shortcomings of the current PT system of instructional staff and identified ways to improve it in order to promote the health, improve physical and mental working capacity of instructors, as well as enhance the effectiveness of their instructional activities.

The survey allowed to determine that the majority of instructors of HEIs SLE want to engage in PT sessions, with preference given to independent training sessions within their daily routine. The answers of the instructors confirm the conclusions of the leading scientists [29, 30] on the positive impact of PT sessions on promoting health, improving working capacity and enhancing the efficiency of service tasks performance.

## CONCLUSIONS

It was found that only 10.3% of instructors regularly exercise in the morning; 85.7% get to the place of service by public transport or by car and only 14.3% go on foot. On

weekends, 41.3% of instructors prefer passive types of motor activity and recreation; more than 50% smoke, in addition, 30.9% smoke one pack or more a day. On top of that, 46.8% of instructors do not engage in physical training at all; 70.7% of them mention that participation in academic studies with cadets is the main reason for skipping their training sessions; 50.9% of instructors answered that they attend training sessions in order to prepare for the test.

It was found that the majority of instructors (67.1%) rarely or almost never follow the standards of a healthy lifestyle. Insufficient efficiency of the current system of physical training of instructional staff was identified and the reasons for insufficient level of physical fitness, health of instructors of HEIs SLE and systematic absence from physical training sessions were revealed.

## PROSPECTS FOR FURTHER RESEARCH

It is intended to investigate the dynamics of the morphofunctional state of instructors of HEIs SLE during their pedagogical activities.

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# The Impact of Health-promoting Technologies on University Students' Physical Development

## Wpływ technologii prozdrowotnych na rozwój fizyczny studentów szkół wyższych

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### SUMMARY

**Aim:** To investigate the impact of training sessions on the ground of health-promoting technologies upon students' physical development in higher educational institutions.

**Materials and Methods:** A group of 50 female students aged 17 to 22 was under our observation for a year. All of them were divided into the experimental (E) and the control (C) groups. The E group female students (n=25) were regularly involved in training sessions using health-promoting technologies, the C group female students (n=25) did not take part in this type of activities.

**Results:** The positive impact of training sessions based on health-promoting technologies upon the physical development of the E group students was revealed. A significantly better level of strength and flexibility development was noted in the E group students, compared to the C one. A statistically significant difference was found after the experiment in the E group students' indicators of static balance, vestibular stability, accuracy of assessment of strength, time and spatial parameters of movements.

**Conclusions:** A rationally constructed system of training sessions based on health-promoting technologies stimulates biological processes, supports the functioning of both individual organs and the students' body as a whole. This will contribute to strengthening students' health, increasing their motor activities, improving the efficiency of both learning and future professional activities.

**Key words:** health-promoting technologies, physical development, motor qualities, health, students

**Słowa kluczowe:** technologie prozdrowotne, rozwój fizyczny, cechy motoryczne, zdrowie, studenci

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### INTRODUCTION

The modern model of the educational process defines a socially significant life strategy for the consistent formation of the health culture of students of pedagogical institutions of higher education i.e. future teachers as a necessary condition for the development of positive motivation of high schoolers and students for a healthy lifestyle [1-3]. Regular motor loads have a positive effect upon the level of a person's functional capabilities, increase emotional stability, reduce morbidity, ensure the acceleration of the warming-up process, contribute to the long-term preservation of the optimal pace, speed and efficiency of work movements [4-6]. The organization of the educational process in institutions of higher education

involves a sufficiently broad study of the issue of preserving and promoting the health of young people, in particular, it involves the development and wide use of appropriate educational technologies aimed at positive self-perception, the value attitude of the individual both to his/her own health and to the health of other people, promotion of a healthy lifestyle and motivation for motor activities [7-9].

The current state of young people's health requires new approaches to the formation of principles of a healthy lifestyle, activation of the promotion of a healthy lifestyle [10-12]. The social significance of the identified problem and its insufficient study determined the choice of the research topic. The priority is the social mandate for an educationalist who possesses

health-promoting technologies of education and upbringing, who is able to organize the health-promoting educational process and develop the health-promoting competence of students [13, 14].

One of the priority directions of the socio-pedagogical activities of teachers (in particular, teachers of biology and the basics of health) is the establishment of cooperation and coordination of the efforts of all links of relevant influence upon the development of the individual with the aim of motivating him/her to a healthy lifestyle, promoting the formation of a young person's motivation for a healthy lifestyle and motor activities [15, 16].

The personal qualities of the teacher affect the results of the high schoolers' work. We believe that future teachers' regular attendance of training sessions with elements of health-promoting technologies will have a motivating effect and contribute to their physical development and improvement of motor quality indicators.

### AIM

The aim is to investigate the impact of training sessions on the ground of health-promoting technologies upon students' physical development in higher educational institutions.

### MATERIALS AND METHODS

The following research methods were used to achieve the aim: informational, which involved studying the current state of the problem on the use of health-promoting technologies in the educational process of students with the aim of improving their physical development; analytical, which involved the analysis of scientific and methodological literature; monitoring of Internet information resources, analysis of theoretical and methodological works; observation method; assessment of physical development of students using motor tests. The research was conducted in several stages. The first stage involved carrying out the analysis and generalization of data from scientific and methodical sources reflecting the state of the problem, development of research organization schemes and selection of the appropriate contingent. The second stage involved scientific substantiation of the use of health-promoting technologies, in particular, the fitness training system for the development of motor skills of students. The third stage consisted in the experimental verification of the effectiveness of the use of health-promoting technologies in the educational process of future teachers.

T.H. Shevchenko National University "Chernihiv Colehium" was chosen as the research base. A group of 50 female students aged 17 to 22 was under our observation for a year. All of them were divided into the experimental (E) and the control (C) groups. The E group female students (n=25) were involved in training sessions using health-promoting technologies, the C group female students (n=25) did not take part in this type of activities.

The E group female students regularly attended "Dilemma" dance and fitness studio for a year, training sessions lasted for one hour three times a week. Programming and organization

of women's training was based on the following provisions: directing health training to the development of general endurance (due to aerobic processes of energy production); limitation of the speed and strength exercises in the health-improving fitness training, which is stipulated by a smaller capacity of anaerobic mechanisms of energy production; the inclusion of strength exercises provided that the state of the pelvic floor is taken into account (the possibility of lowering the pelvic organs with the increase in the internal abdominal pressure). The main objective of the training sessions was to enhance the physical development of female students, promote the health of various systems of the body and improve their emotional state. The tasks of the training sessions included: promotion of health, improvement of vitality, enhancement of general and special working capacity, development of physical abilities, formation of the body posture and correction of body build abnormalities, prevention of pathological conditions and professional illnesses. The following recommendations were taken into account while determining the intensity of the physical load according to the indicators of the maximal oxygen consumption (MOC): the training load was within the boundaries of 65-75% of the MOC for female students with a high level of physical well-being, 50-65% of the MOC for students with an average level of physical well-being, 40-50% of the MOC for female students with a low and below average levels of physical well-being. At that time, the C group female students performed exercises that ensured their motor activities at their own discretion.

The determination of the indicators of physical development of female students was carried out according to the following indicators: the indicator of the development of strength qualities (push-ups, times), the indicator of the development of speed and strength qualities (standing long jump, cm), the indicator of the development of agility (4×9 m shuttle run, s), the indicator of flexibility development (torso tilt forward from a sitting position, cm), the indicator of static balance (one leg balance, s), the indicator of vestibular stability (Romberg coordination test, s), the indicators of kinesthetic sensation (hand dynamometry method, %), the indicators of time orientation (determination of an individual minute, s), the indicator of spatial orientation (basketball dribbling with one hand when changing the direction of movement, s), speed of a simple reaction ("Catch the ruler" method, cm), speed of attention ("Collect puzzles" method, min).

During the exams, the reliability of the difference between the students' indicators at the beginning and at the end of the research was determined using the Student's t-test. Significance for all statistical tests was set at  $p < 0.05$ . The difference was also presented as a percentage.

### RESULTS

The indicators that were taken before the start of the experiment were compared in order to determine the homogeneity of the groups. With the help of the comparative analysis of the indicators of female students' motor readiness, it was concluded that the most of the E and the C groups

**Table 1.** Dynamics of the indicators of motor readiness of female students ( $M \pm m$ ,  $n=50$ )

Tests	Groups	Beginning of the experiment	End of the experiment	Rate of growth
Push-ups, times	E	11.2±1.0	13.1±1.0*	16.9%
	C	11.1±0.6	11.3±0.6	1.8%
Standing long jump, cm	E	212.5±4.5	212.5±4.6	0.00%
	C	212.6±3.7	213.7±3.4	0.5%
4×9 m shuttle run, s	E	10.1±0.2	9.9±0.2	2.00%
	C	10.3±0.1	10.3±0.1	0.00%
Torso tilt forward from a sitting position, cm	E	12.0±1.0	13.5±1.0*	12.5%
	C	11.5±0.4	12.6±0.4	9.5%

Note:  $M$  – the arithmetic mean,  $m$  – the error of the mean-square deviation, \* – the reliability of the difference between the indicators of female students at the beginning and at the end of the research at the level of  $p \leq 0.05$

indicators were not significantly different from each other at the beginning of the experiment ( $p > 0.05$ ) (Table 1).

At the end of the experiment, the E group students' indicators increased in almost all motor tests, the biggest changes were registered when determining the development of arm strength and quantitative indicators in torso tilt forward from a sitting position: an increase of 16.9% and 12.5%, respectively. Positive dynamics were also noted in the time of shuttle running by 2%. Positive dynamics were also noted in the C group students when studying the specified indicators of motor readiness, but to a much lesser extent.

Checking the level of physical development of female students of both groups revealed the presence of reliable changes in the indicators of the representatives of the experimental group after the year of the experiment (Table 2).

As it can be seen from the data presented in Table 2, the increase in the indicator of static balance in the E group students was 18.6%, which is significantly more than in the C group students. According to the obtained results, the indicators of vestibular stability, kinesthetic sensation, time and spatial orientation also reliably ( $p \leq 0.05$ ) improved in the E group female students. The studied indicators also improved in the C group female students, however,

the difference between the data at the beginning and at the end of the experiment is unreliable ( $p > 0.05$ ). The rate of growth in the indicators of speed of a simple reaction (improvement is 1.5%), speed of attention (improvement is 3.1%) is insignificant and statistically unreliable ( $p > 0.05$ ) in the E group female students.

## DISCUSSION

According to many scientists [17, 18], the implementation of health-promoting technologies should be aimed at indicators of health, physical development and physical fitness of students. A number of scientific works by specialists in many countries of the world are devoted to the issue of implementing modern methods for strengthening and preserving the health of student youth [19-22]. The scientists have proven the positive impact upon the body of students of such modern technologies as Kangoo Jumps, Pilates, aqua aerobics, swimming, stretching, various types of dance and fitness, and many others [5, 8, 12, 15, 23, 24]. At the same time, the study of the issue of improving the specific motor abilities of female students in the process of training sessions on the ground of health-promoting technologies remained without due attention of specialists.

**Table 2.** Dynamics of the indicators of physical development of female students ( $M \pm m$ ,  $n=50$ )

Tests	Groups	Beginning of the experiment	End of the experiment	Rate of growth
Static balance, s	E	14.0±0.5	16.6±1.0*	18.6%
	C	14.0±0.6	14.3±0.6	2.1%
Vestibular stability, s	E	28.0±0.5	31.0±0.6*	10.7%
	C	27.0±1.7	28.0±1.4	3.7%
Kinesthetic sensation, %	E	13.0±0.2	11.5±0.2*	11.6%
	C	14.0±0.1	13.5±0.1	3.6%
Indicator of time orientation, s	E	52.0±1.5	58.5±1.0*	12.5%
	C	45.5±4.4	46.6±3.4	2.4%
Indicator of spatial orientation, min	E	1.0±0.0	0.9±0.0*	10%
	C	1.0±0.2	1.2±0.4	20%
Speed of a simple reaction, cm	E	0.217±0.002	0.212±0.004	1.5%
	C	0.242±0.003	0.240±0.003	0.9%
Speed of attention, min	E	14.4±1.5	13.6±1.2	3.1%
	C	16.1±1.5	15.4±1.0	3.1%

Note:  $M$  – the arithmetic mean,  $m$  – the error of the mean-square deviation, \* – the reliability of the difference between the indicators of female students at the beginning and at the end of the research at the level of  $p \leq 0.05$

Specific motor abilities that characterize the physical development of a person are quite diverse. Among them, we can distinguish the ability for differentiation, orientation, sense of balance, speed of reaction and attention [5, 25]. They are the most significant, because they are manifested in working practice, sports activities, and everyday life. In particular, the speed of motor reactions is determined by the mobility of nervous processes, and the frequency of movements depends on the mobility of the neuromuscular apparatus: the frequency of neuromuscular impulses, the speed of muscle transition from the tension phase to the relaxation phase, the rate of alternation of these phases, the degree of inclusion of “fast” muscle fibres in the process of movement and their synchronous work, they are characterized by hereditary features and are best developed in sensitive periods. In addition, motor skills are the basis of physical development of students, as well as a prerequisite for effective training in physical exercises, as they ensure the coordination and arrangement of various motor actions into a single whole in accordance with the set goal [26–28].

A statistically significant difference after the experiment was shown by the results of the indicators of static balance (18.6%), vestibular stability (10.7%), accuracy of assessment of force, time and spatial parameters of movements (11.6%, 12.5% and 10%, respectively). The rate of growth in the indicators of speed of motor reactions (1.5%) and speed of attention (3.1%) is insignificant and statistically unreliable. The analysis of the obtained results showed that the systematic attendance of dance and fitness training sessions, which are based on the application of health-promoting technologies, contributed to the increase in the motor activities of female students, and this, in turn, led to an improvement in their physical development.

## CONCLUSIONS

The positive influence of training sessions on the ground of health-promoting technologies upon the physical development of female students was revealed. The female students of the experimental and control groups showed positive dynamics of physical development indicators, in particular, the female students of the experimental group increased the indicators in almost all motor tests, the biggest changes were registered when studying the indicators of the development of arm strength and torso flexibility: the indicators of push-ups improved by 16.9%, the indicators of torso tilt forward from a sitting position – by 12.5%. Positive shifts in agility indicators were also noted i.e. the shuttle running time improved by 2%. A significant improvement in the indicators of the physical development of female students of the experimental group, compared to the representatives of the control group, was also established, according to the indicators of static balance (by 18.6%), vestibular stability (by 10.7%), kinesthetic sensation (by 11.6%), time orientation (by 12.5%) and spatial orientation (by 10%).

The obtained results allow us to state that a rationally constructed system of training sessions on the ground of health-promoting technologies contributes to improving

the physical development of students, strengthening their health, and increasing their motor activities, which, in general, will ensure the effectiveness of both educational and future professional activities.

Prospects for further research are aimed at studying the state of formation of health-saving competence among students in the process of their preparation for professional activities.

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# Organizational and Methodological Approaches to Providing the Population of Territorial Communities with Physical Rehabilitation

## Aspekty organizacyjne i metodologiczne zapewnienia ludności gmin terytorialnych rehabilitacji ruchowej

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### SUMMARY

**Aim:** To substantiate and develop organizational and methodological approaches to providing the population with physical rehabilitation at the level of territorial communities.

**Materials and Methods:** The following methods were used in the course of the study: of expert assessments to conduct an expert evaluation of the proposed innovations; medico-statistical to carry out statistical processing of primary information; of structural-and-logical analysis to analyze and present organizational and methodological approaches to providing the population of territorial communities with physical rehabilitation; bibliosemantic in order to study the existing approaches and the state of solving this issue in Ukraine.

The Legislative acts of Ukraine on administrative-and-territorial reform and creation of territorial communities, as well as on the development of a system of physical rehabilitation in the country; scientific information sources on the experience of solving this issue in the countries of the world and Ukraine; results of expert evaluation of the proposed innovations were used as the materials of the study. Among the experts there were: 5 scientists, 5 specialists in physical rehabilitation, 5 heads of territorial communities, 3 family doctors, 3 residents of territorial communities in need of physical rehabilitation.

**Results:** Organizational and methodological approaches to providing the population with physical rehabilitation and physical activity at the level of territorial communities have been substantiated and developed. The approaches are comprehensive and cover both managerial and organizational and financial aspects.

**Conclusions:** Implementation of measures for physical rehabilitation and physical activity at the level of territorial communities will ensure further preservation and strengthening of health of the population.

**Key words:** territorial communities, physical rehabilitation, providing

**Słowa kluczowe:** wspólnoty terytorialne, rehabilitacja ruchowa, zapewnienie

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### INTRODUCTION

The analysis of information sources indicates that administrative-and-territorial reform is being actively carried out in Ukraine with the formation of territorial communities [1-3]. At the same time, at the legislative level, the issue of providing territorial communities with appropriate funding was resolved [4, 5], which should be used to solve priority tasks. These tasks include the preservation and promotion of public health. An important role in this process is performed by physical rehabilitation, as a component of an integrated system of medical care. The active development of physical rehabilitation in Ukraine has been taking place recently, which is defined at the legislative level [6, 7].

There were no comprehensive scientific studies in Ukraine devoted to the issues of providing physical rehabilitation of the population at the level of territorial communities, which determined the relevance of this study.

### AIM

The aim of this work was to substantiate and develop organizational and methodological approaches to providing the population with physical rehabilitation and controlled physical activity at the level of territorial communities.

### MATERIALS AND METHODS

The following methods were used in the course of the study:

- of expert assessments to conduct an expert evaluation of the proposed innovations;
- medico-statistical to carry out statistical processing of primary information;
- of structural-and-logical analysis to analyze and present organizational and methodological approaches to providing the population of territorial communities with physical rehabilitation;
- bibliosemantic in order to study the existing approaches and the state of solving this issue in Ukraine.

The Legislative acts of Ukraine on administrative-and-territorial reform and creation of territorial communities, as well as on the development of a system of physical rehabilitation in the country; scientific information sources on the experience of solving this issue in the countries of the world and Ukraine; results of expert evaluation of the proposed innovations were used as the materials of the study. Among the experts there were: 5 scientists, 5 specialists in physical rehabilitation, 5 heads of territorial communities, 3 family doctors, 3 residents of territorial communities in need of physical rehabilitation.

For the application of these materials and methods during the study, permission was obtained from the ethical commission of Uzhhorod National University. Protocol dated 21.04. 2022 № 9/2 .

## RESULTS

To achieve the determined goal at the level of the territorial community, it is necessary to solve a number of tasks.

The first task to be solved is to determine the persons who need physical rehabilitation and controlled physical activity. In accordance with the WHO recommendations [8, 9], such a contingent includes persons with chronic diseases, who are usually progressive in nature and people with special needs and disabilities who need medical rehabilitation and social assistance. Therefore, at the first stage of solving the problem, it is necessary to determine who, their number and, accordingly, the need for types of physical rehabilitation and controlled physical activity.

Structurally the entire population of the community is divided into four clusters: a population with risk factors for developing chronic diseases, a population with chronic non-communicable diseases that requires regular dosed and controlled physical activity; persons after inpatient treatment requiring outpatient physical rehabilitation for a certain time and persons with disabilities. This problem can be solved by a family doctor in cooperation with social services.

The second task to be solved is to determine who will carry out the physical rehabilitation of certain contingents. To solve this problem, the leadership of the territorial community should invite, on the terms of the contract, the necessary specialists, possibly from among university graduates. The terms of the contract should satisfy the community and promote the effective professional activity of the specialist and keep him in the community for the future.

The third task is to solve the issue of the place for training, which requires the allocation of premises for the creation of

an outpatient rehabilitation center that meets sanitary and hygienic requirements and ensures the safety of the patient and the specialist during the training. The best place may be a special room in the family outpatient clinic. This will allow and ensure the cooperation of a specialist in physical rehabilitation and a family doctor in the process of physical rehabilitation.

The next fourth task is to solve the issue of resource support for the center of physical rehabilitation and dosed physical activity, which is created in the territorial community. The provision of medical devices must be not lower than that determined by industry requirements.

The fifth task is urgently important for the solution. This is funding for the establishment and operation of a center for physical rehabilitation and dosed physical activity of the community. To solve this problem, we propose the following approaches.

First. Solving the issue of creating the center for one territorial community or for several communities. This entails a legal solution to both financial and organizational issues of the center.

Second. Conclusion of agreements with the National Health Service of Ukraine for state funding under the following packages of medical services: “Medical rehabilitation of adults and children from three years old with lesions of the musculoskeletal system” and “Medical rehabilitation of adults and children from three years old with damage to the nervous system”.

Third. In accordance with the Law of Ukraine from July 1, 2022 № 2347-IX “On Amendments to Certain Legislative Acts of Ukraine on Improving the Provision of Medical Care”, the solution of the issue of co-payment by the population for the services received in physical rehabilitation and physical activity.

In solving the issue of preserving and strengthening the health of the population of the territorial community, we propose the adoption of a targeted comprehensive local program in which providing the population with comprehensive services for physical rehabilitation and activity is an important component.

The adoption of the appropriate program and the creation of a center for physical rehabilitation and physical activity requires conducting among the population of the territorial community or several communities that are the founders and owners of this center of wide information and communication work, the purpose of which is to form among the population:

- responsible attitude to personal health;
- readiness to use physical rehabilitation and controlled physical activity services in a motivated manner.

In addition, the population should be informed about the procedure for obtaining relevant services and the schedule of the center.

According to the research program, the proposed innovations were evaluated by independent experts. The results of the expert assessment are shown in the Table 1.

The analysis of the data presented in the table indicates that independent experts mostly support the proposed measures for

**Table 1.** The results of expert assessment of organizational and methodological approaches to providing the population of territorial communities with physical rehabilitation

Factor	abs.	%
Adoption of a targeted comprehensive local program for the preservation and promotion of health of the population of the territorial community	19	90,5
Creation of a center for physical rehabilitation and physical activity	20	95,2
Creation of a center on the base of a family outpatient clinic	20	95,2
Creation of a center for several territorial communities	17	80,9
Creation of a center for one territorial community	4	19,1
Involvement of specialists on a contract terms	18	85,7
Co-payment of the population for receiving services in the center	15	71,4
Comprehensive information and communication work among the population	17	80,9

the implementation at the level of territorial communities of a system for the provision of physical rehabilitation services to the population and the provision of services for the organization of dosed and controlled physical activity.

## DISCUSSION

Taking into account the methodological approaches recommended by WHO to maximize the provision of medical-and-social services at the place of residence for Ukraine, in the context of administrative-and-territorial reform, territorial communities become the basic level of providing the population with services for physical rehabilitation and physical activity [8, 9].

The introduction at the level of territorial communities of the system of providing the population with services for physical rehabilitation and physical activity depends on the political will of the community leaders and the financial viability of the community [1, 2].

In solving the issue of providing the population of the territorial community with services for physical rehabilitation and physical activity, it is necessary to solve the following tasks: to determine the contingents and their number that need such services; to decide who will provide them with these services and create an appropriate material and technical base for this. The main task is to ensure proper financing of this type of activity. Ensuring an effective solution to these tasks will be facilitated by the adoption of a targeted local program for the preservation and promotion of public health in which providing the population with comprehensive services for physical rehabilitation and activity is an important component [6, 7].

The proposed measures to create a territorial center for physical rehabilitation and physical activity, supported by independent experts, will provide the population with services to restore and strengthen the health of the population.

## CONCLUSIONS

Organizational and methodological approaches to providing the population with physical rehabilitation and controlled

physical activity at the level of territorial communities have been substantiated and developed.

The approaches are comprehensive and cover both managerial and organizational and financial aspects.

Implementation of physical rehabilitation measures at the level of territorial communities will ensure further preservation and strengthening of health of the population.

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# Changes in Physical and Mental Health Indicators of Law Enforcement Officers in the Process of their Professional Activities

## Zmiany we wskaźnikach zdrowia fizycznego i psychicznego funkcjonariuszy organów ścigania w trakcie ich aktywności zawodowej

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### SUMMARY

**Aim:** To study the level and dynamics of physical and mental health indicators of officers-in-charge of police organizations in the process of their professional activities.

**Materials and Methods:** The research which was conducted in the period from 2019 to 2021 and involved 155 law enforcement officers (men) of different age groups, who held superior positions in various police departments. The physical health of law enforcement officers was assessed according to the method of H.L. Apanasenko, mental – using a mix of psychodiagnostic methods.

**Results:** It was found that the level of physical health of the officers-in-charge of police organisations is significantly deteriorating with increase in their age and professional experience. The level of health of the majority of superior law enforcement officers is below average and low. The negative dynamics of health indicators of law enforcement officers was revealed during the research period. It was found that the law enforcement officers with a high level of physical fitness have significantly better indicators of mental health than the ones with a low level of physical fitness.

**Conclusions:** One of the main reasons for the low level of physical and mental health of superior police officers is the lack of effectiveness of physical training sessions and, as a result, their low level of physical fitness. All this requires the improvement of physical training with this category of law enforcement officers in order to strengthen their physical and mental health and improve the indicators of their professional activities.

**Key words:** physical health, mental health, officers-in-charge of police organizations, law enforcement officers

**Słowa kluczowe:** zdrowie fizyczne, zdrowie psychiczne, funkcjonariusze kierujący organizacjami policyjnymi, funkcjonariusze organów ścigania

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### INTRODUCTION

Health has always been considered one of the highest values of society, which is the basis of economic and spiritual development of the state. Maintaining and promoting health ensures the continuation of an active working period of life. According to the World Health Organization (WHO), human health depends largely on four main factors: lifestyle – 50%, heredity – 20%, environment – 20%, health system – 10% [1].

The scientists [2, 3] claim that lifestyle is one of the key factors influencing human health. The life and work of modern man is too rich in terms of requirements for the ability to perceive and transform large amounts of information. At the same time, modern technologies, which are designed to facilitate the life of modern man, result in a significant reduction in motor activity [4]. All of the above is especially acute for the heads of any structures and organizations, especially

the officers-in-charge of police organizations. Professional activities of officers-in-charge of police organizations of any level of management are carried out in quite difficult conditions, including: aggressive communication environment, working time shortage, high responsibility for performance, the emergence of various extreme situations [5]. Superior law enforcement officers face many specific stressors every day, most of which are continuous and durable in nature. It results in the emergence of fatigue, general and occupational diseases, premature burnout and aging [6].

According to the scientists [7, 8], in addition to changes coming from the democratization of the agency and Ukrainian society as a whole, a complication of the criminogenic situation due to both globalization of crime and military aggression against Ukraine, as well as permanent legislative reform also creates the additional burden on law enforcement officers. These various stressors (reform of the judiciary and law enforcement system, democratization of society, globalization of crime, military operations and increased arms trafficking) necessitate the search for effective ways to overcome the negative factors of professional activities of officers-in-charge of police organisations and preserve their health and prolong professional active ageing.

One of the important factors in combating the stressors of professional activities of officers-in-charge of police organisations as well as strengthening their physical and mental health is physical training, which is aimed at comprehensive harmonious development of employees, preservation of health, education of high moral and volitional qualities, formation of special skills, instilling the need for physical and moral improvement in personnel, formation of readiness to perform service duties [9, 10]. Our research aims to assess the level and dynamics of physical health indicators of superior law enforcement officers of different age groups and compare the level of their mental health (through indicators of professionally important psychological qualities of law enforcement officers) in employees with high and low levels of physical fitness.

## AIM

The aim is to study the level and dynamics of physical and mental health indicators of officers-in-charge of police organizations in the process of their professional activities.

## MATERIALS AND METHODS

The research which was conducted in the period from 2019 to 2021 and involved 155 law enforcement officers (men) of different age groups, who held superior positions in various police departments of Ukraine: 25-30 years old – officers-in-charge of sectors of territorial police units (n=39), 30-35 years old – officers-in-charge of divisions of territorial police units (n=33), 35-40 years old – officers-in-charge of stations of territorial police units (n=30), 40-45 years old – officers-in-charge of directorates within the main police departments (n=29), 45 years and older – officers-in-charge of departments and other units of the central office of the National Police (n=24). The research was conducted at the Department of Legal Psychology, National Academy of Internal Affairs (NAIA), Kyiv, Ukraine.

Research methods: theoretical analysis of literature sources, pedagogical observation, medical and biological methods, psychological testing, questionnaires, methods of mathematical statistics. The physical health of law enforcement officers was assessed according to the method of H.L. Apanasenko, which is based on indicators of anthropometry (height, body weight, vital capacity of the lungs, wrist dynamometry), as well as the state of the cardiovascular system (heart rate, blood pressure, duration of recovery processes). The level of physical health was determined by the sum of the points obtained for determining the indices of body weight, vitality, strength, Robinson and the duration of recovery of heart rate after exercise. The sum of points in the amount of < 3 determined the level of physical health of law enforcement officers as low; 4-6 points – below average; 7-11 – average; 12-15 – above average; 16-18 – high [11]. Furthermore, we conducted the survey of law enforcement officers to study their subjective opinion about their own level of health in order to compare the real level of physical health of the officers-in-charge of police organizations with the results of their self-assessment of their own health. The mental health of law enforcement officers was assessed using a set of psychodiagnostic methods that allowed to determine the level of their professionally important psychological qualities and mental working capacity: correction task of Bourdon-Anfimov (assessment of concentration and stability of attention, as well as the level of mental working capacity); the test of finding numbers (assessment of distribution and scope of attention); the methods of operating with numbers (assessment of operative and spontaneous memory); the method of associations research (assessment of thinking peculiarities); the method of studying well-being, activity and mood (WAM) (assessment of emotional state) [12].

This study followed the regulations of the World Medical Association Declaration of Helsinki – ethical principles for medical research involving human subjects. The procedure for organizing this study was previously agreed with the committee on compliance with Academic Integrity and Ethics of the NAIA. Informed consent was received from all participants who took part in this study.

## RESULTS

The analysis of the health status of the superior personnel of the National Police of Ukraine shows that the level of law enforcement officers of all age groups is decreasing in terms of their physical health during the research, but no significant difference was revealed between the indicators of 2019-2021 ( $p > 0.05$ ) (Table 1). At the same time, this gives grounds to predict further deterioration of the health of law enforcement officers in the course of their professional activities. The level of health of officers-in-charge of police organisations is significantly deteriorating with their age increment, the worst level of physical health at all stages of the research was found in law enforcement officers over 45 years. Thus, the difference between the level of physical health of law enforcement officers under 30 and over 45 in 2019 is 1.88 points, in 2020 – 2.04 points, in 2021 – 2.13 points ( $p > 0.05$ ).

**Table 1.** The level and dynamics of physical health indicators of officers-in-charge of police organizations of different age groups in the process of their professional activities (2019-2021, n=155, Mean±SD)

Stages of research	Age groups, years				
	25-30	30-35	35-40	40-45	45 and older
	n=39	n=33	n=30	n=29	n=24
2019	5.17±0.49	4.58±0.55	4.29±0.61	4.02±0.62	3.29±0.63
2020	5.12±0.47	4.41±0.58	4.12±0.59	3.83±0.63	3.08±0.65
2021	5.04±0.50	4.33±0.59	4.06±0.60	3.69±0.64	2.91±0.67

Legend: Mean – arithmetic average, SD – standard deviation.

**Table 2.** Assessment of the physical health level of officers-in-charge of police organisations of different age groups (2019-2021, n=155, %)

Stages of research	Levels of physical health				
	Low	Below average	Average	Above average	High
Law enforcement officers aged 25-30 years (n=39)					
2019	23.1	51.3	20.5	5.1	–
2020	30.8	48.7	17.9	2.6	–
2021	33.3	48.7	15.4	2.6	–
Law enforcement officers aged 30-35 years (n=33)					
2019	24.2	54.5	15.2	6.1	–
2020	27.3	54.5	12.1	6.1	–
2021	30.3	57.6	9.1	3.0	–
Law enforcement officers aged 35-40 years (n=30)					
2019	40.0	43.3	13.3	3.4	–
2020	43.3	43.3	10.0	3.4	–
2021	50.0	40.0	6.7	3.4	–
Law enforcement officers aged 40-45 years (n=29)					
2019	41.4	48.3	10.3	–	–
2020	48.3	44.8	6.9	–	–
2021	51.7	41.4	6.9	–	–
Law enforcement officers aged 45 years and older (n=24)					
2019	50.0	45.8	4.2	–	–
2020	54.2	41.6	4.2	–	–
2021	58.3	37.5	4.2	–	–
Law enforcement officers of all age groups together (n=155)					
2019	34.2	49.1	13.5	3.2	–
2020	39.4	47.1	10.9	2.6	–
2021	43.2	45.8	9.1	1.9	–

No significant difference was found between the indicators of law enforcement officers of adjacent age groups ( $p > 0.05$ ). It was found that the level of health of the vast majority of superior personnel is below average and sometimes low; the overall score according to the method of H.L. Apanasenko ranges from 5.17 to 2.91 points.

Assessing the level of physical health of officers-in-charge of police organisations by age group shows that the largest number of superior police officers under the age of 30, 35 and 40 have a below average level of physical health, and under the age of 45 and over 45 – low. Thus, the superior officers under 30 years of age revealed a below average level of health in 48.7-51.3% depending on the stage of the research; up to 35

years of age – in 54.5-57.6%; up to 40 years of age – in 40.0-43.3%. The superior personnel under the age of 45 showed a low level of health in 41.4-51.7%; in law enforcement officers over 45 years of age – in 50-58.3% (Table 2). The officers-in-charge of police organisations of all age groups revealed a similar trend in their physical health over the research period: a decrease in the number of law enforcement officers with average and above average levels, and an increase in the number of law enforcement officers with low levels. It is noteworthy that no officers-in-charge of police organizations revealed a high level of health.

The results of our research are confirmed by the analysis of the number of superior law enforcement officers who are

**Table 3.** Self-assessment of officers-in-charge of police organizations in terms of their own health (n=155, %)

Question	Answer options	Age groups, years					Total n=155
		25-30	30-35	35-40	40-45	45 and older	
		n=39	n=33	n=30	n=29	n=24	
How do you assess your own health?	perfect	–	–	–	–	–	–
	good	28.2	21.2	13.3	6.9	8.3	16.8
	satisfactory	66.7	63.6	46.7	55.2	50.0	57.4
	unsatisfactory	5.1	15.2	40.0	37.9	41.7	40.0
	own answer	–	–	–	–	–	–

in the group of exercise therapy (ET). Thus, the analysis of the lists of law enforcement officers who are assigned to the group of ET showed that more than 30% of law enforcement officers from all the studied superior personnel are not allowed to engage in physical training. At the same time, there is a negative trend: if the exercise therapy group included 29.6% of the superior personnel in 2019, then in 2021 – 33.5%.

Examining the level of self-assessment by the officers-in-charge of police organizations of their own health, it was found that the vast majority of law enforcement officers (57.4%) assess their own health as satisfactory; 40.0% of respondents consider their health unsatisfactory; 16.8% – good (Table 3). At the same time, none of superior officers rated his health as “perfect”. The vast majority of superior officers who have assessed their health as unsatisfactory belong to the age group of 40 years and older. The dynamics of self-assessment indicators of superior officers’ own health has a similar trend to the indicators of physical health research: the number of law enforcement officers with a low (unsatisfactory) level of health increases with age.

The research confirms our previous findings about the lack of physical health of superior officers, especially after the age of 40, which does not allow them to perform their service duties effectively enough.

The managerial activity of the officers-in-charge of police organizations places high demands on the development of not only physical but also mental health, which is also manifested in the development of professionally important psychological qualities. These include the ability to simultaneously perceive

several objects (scope of attention), perform several actions simultaneously (distribution of attention), focus on one object (concentration of attention), the ability to maintain the required intensity of attention for a long time (stability of attention), mental working capacity, and positive emotional state. Law enforcement officers were divided into two groups in order to check the level of development of their professionally important psychological qualities: group No.1 corresponded to a low level of physical fitness (this group included superior officers who received an unsatisfactory score (n = 59) according to the results of the last test on physical training in 2021; group No.2 – high (this group included superior officers who received a positive score (n = 96)). The percentage of personnel in groups No.1 and No.2 by age groups was the same. The results are given in Table 4.

The research shows that superior officers with a high level of physical fitness are characterised by better distribution, scope, concentration, stability of attention, memory and thinking, but no significant difference between the indicators of groups No.1 and No.2 was found ( $p > 0.05$ ). The positive effect of exercise was on the indicators of mental activity and emotional state of law enforcement officers. Thus, the law enforcement officers of group No.2 showed significantly better mental performance indicators than group No.1 by 78.2 c.u. ( $p < 0.05$ ). Well-being, activity and mood in group No.2 were also significantly ( $p < 0.001$ ) better than in group No.1, by 1.13, 1.43 and 0.68 c.u.6 correspondingly. This shows the positive impact of physical training sessions on the development and improvement of professionally important psychological

**Table 4.** Comparative analysis of the level of development of professionally important psychological qualities of officers-in-charge of police organizations with low (group No.1) and high (group No.2) levels of their physical fitness (Mean±SD, n=155, c.u.)

Studied indicators	Group No.1 (n=59)	Group No.2 (n=96)	Significance of the difference	
			t	p
Distribution and scope of attention	8.02±0.08	8.17±0.06	1.50	>0.05
Operative and spontaneous memory	8.19±0.09	8.24±0.07	0.44	>0.05
Thinking peculiarities	7.02±0.09	7.09±0.08	0.58	>0.05
Concentration and stability of attention	88.4±2.13	92.2±1.64	1.41	>0.05
Mental working capacity	1117.9±23.4	1196.1±19.3	2.58	<0.05
Well-being	5.71±0.10	6.84±0.08	8.82	<0.001
Activity	6.12±0.09	7.55±0.07	12.54	<0.001
Mood	7.13±0.08	7.81±0.07	6.40	<0.01

qualities and, consequently, the mental health of officers-in-charge of police organisations, which will ensure their effective performance of professional tasks.

## DISCUSSION

Health is the most important factor in the implementation of the life program of the individual, which largely determines the implementation of social tasks. According to the WHO [1], health is defined as the state of a person, who is characterized not only by the absence of disease or physical defects, but also complete physical, mental and social well-being. The scientists [13] claim that a person can be considered healthy if he/she is characterized by harmonious physical and mental development and well adapted to the surrounding physical and social environment. The scientists [4, 11] present the concept of physical health as a state of the organism in which the integral indicators of the basic physiological systems are within the physiological norm and change adequately during human interaction with the environment. Mental health is defined by the scientists as the level of psychological well-being, which is determined not only by the absence of mental illness, but also by a number of socio-economic, biological and environmental factors [12]. Based on the above, it can be stated that a healthy person is able to fully realize his/her physical and mental abilities and fulfil his/her social purpose. The scientists [14, 15] note that the state of physical and mental health of the population of Ukraine has significantly deteriorated over the past 30 years. The factors that lead to the deterioration of the health of the population of Ukraine, including officers-in-charge of police organizations, according to the experts [16, 17] include various stressors: external; organizational; factors related to service duties; personal. External stressors cause frustrations related to the practice of unit management, the practice of the judiciary, the activities of the media, as well as negative attitudes towards the police on the part of the population. Organizational stressors are related to insufficient financial support, excessive "paperwork", and lack of administrative support from top law enforcement officials. Stressors related to service responsibilities arise from the constant confrontation with tragedy and people in trouble, the problems of subordinates, as well as the fear, danger and boredom inherent in managerial work. Personal stressors include concerns about individual success and security, pressure from top officials and stressors arising from policing: health, family problems. Often law enforcement officers develop the ability to cope with the psychological stress of their work, becoming emotionally disconnected. Over the length of service, this emotional alienation is extended to family life. The researchers [18, 19] also note that the performance of service duties in difficult conditions, where there is a threat to the health and life of not only individual but also subordinates, results in negative consequences, first and foremost in the mental sphere. Strict requirements for the actions of law enforcement officers and strict legal regulation of their professional activities are one of the levers of negative impact on the mental health of law enforcement officers. This requires them to have a high psychological readiness for service activities. In view of the

above, finding ways and justifying measures and means to promote and maintain the physical and mental health of officers-in-charge of police organisations is one of the most pressing issues.

Our research confirmed the findings of many scientists [20, 21] that negative factors in the professional activities of officers-in-charge of police organisations negatively affect the level of their physical and mental health. Most of the surveyed law enforcement officers have below average and low levels of physical health, and no leader is characterised by a high level of health. One of the main reasons for this problem is the lack of effectiveness of physical training sessions and, as a consequence, the low level of physical fitness of officers-in-charge of police organisations. This statement is confirmed by the indicators of the research of mental health of law enforcement officers. It was found that the leaders who have a higher level of physical fitness also have better mental health and professionally important psychological qualities compared to law enforcement officers who have a low level of physical fitness.

## CONCLUSIONS

It was found that the level of physical health of the officers-in-charge of police organisations is significantly deteriorating with increase in their age and professional experience. The level of health of the majority of superior law enforcement officers is below average and low. The negative dynamics of health indicators of law enforcement officers was revealed during the research period: the number of law enforcement officers with average level of physical health decreased, and the number with low level increased. None of the law enforcement officers was found to have a high level of health. Significantly better indicators of mental health (well-being, activity, mood, mental working capacity) were revealed in law enforcement officers who have a high level of physical fitness, compared to those who have a low level of physical fitness.

One of the main reasons for the low level of physical and mental health of officers-in-charge of police organisations is the lack of effectiveness of physical training sessions and, as a result, their low level of physical fitness. All this requires the improvement of physical training with this category of law enforcement officers in order to promote their physical and mental health in the process of professional activities.

## PROSPECTS FOR FURTHER RESEARCH

It is planned to determine the relationship between the health indicators of law enforcement officers and the level of development of their physical qualities.

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# Health-improving Effect of Engagement in Different Types of Motor Activities for Cadets of Higher Military Educational Institutions

## Prozdrowotny efekt zaangażowania podchorążych wyższych wojskowych instytucji edukacyjnych w różnego rodzaju zajęcia ruchowe

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### SUMMARY

**Aim:** To investigate the impact of various sports on the level of physical health of cadets of higher military educational institutions.

**Materials and Methods:** 113 cadets took part in the research, which was conducted in 2017-2021. The cadets of interest attended the sports clubs in various sports: competitive sports (n=27), all-around military sports (n=16), strength sports (n=23), martial arts (n=26), strength endurance (n=21). The level of cadets' physical health was assessed by morphological (body length, body mass, vital lung capacity, hand dynamometry) and functional (heart rate, blood pressure) indicators.

**Results:** It was found that physical exercises and sports aimed at developing endurance and strength qualities have the greatest health-improving effect. The cadets, who during their training were engaged in all-around military sports, military pentathlon, sports orienteering, kettlebell lifting, crossfit, have the highest level of physical health characterised by 12.11-12.34 points.

**Conclusions:** The conclusions of many scientists were confirmed that motor activities are the main factor of good human health. It was established that rationally organized training sessions in the sports clubs of the military educational institution on various types of sports have a positive health-improving effect on the cadets' body. This, in turn, will contribute to increasing the resistance of their body to adverse environmental factors, compliance with the standards of a healthy lifestyle and improving their working capacity during the performance of assigned tasks.

**Key words:** physical health, various sports, physical exercises, cadets

**Słowa kluczowe:** zdrowie fizyczne, różne sporty, ćwiczenia fizyczne, kadeci

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### INTRODUCTION

The beginning of the third millennium was characterized by negative trends in the state of health of the population of Ukraine. According to the interpretation of the World Health Organization (WHO), human health is characterized by a state of complete physical, mental and social well-being, and not only by the absence of diseases or physical defects. Therefore, a person is considered healthy who has harmonious physical and mental development, is well adapted to the external natural and social environment that surrounds him/her, fully realizes his/her physical and mental abilities.

The health of servicemen largely depends on the way of their life, the specifics of professional activities, stressful agents and socio-economic conditions [1, 2]. The state of health of cadets of higher military educational institutions (HMEIs) is also affected by specific factors of the educational process and risk factors of military service: a large volume of educational information, neuro-emotional stress, intellectual overload, stress, performance of duties against the background of fatigue, sharp decrease or increase in motor activities, violation of normal daily biological rhythms on the account of the combat mode of round-the-clock performance of duties, etc [3, 4].

According to many scientists [5, 6], insufficient physical activities are one of the main factors that negatively affect a person's health, along with an irrational diet, smoking and excessive consumption of alcoholic beverages. Available and effective forms of motor activities, specially organized as part of physical education and health training sessions, performed independently or under the guidance of specialists, are especially in demand, taking into account the negative trends in the health of the population of Ukraine [7, 8]. The scientists [9, 10] recommend the wider use of effective and affordable forms and means of health promotion in the system of physical training for HMEI cadets. Sporting and mass participation events (SMPEs) are one of the main forms of physical training in HMEIs, which are aimed at attracting cadets to active military-applied, mass participation and other types of sports, increasing the volume of motor activities, improving sports skills and physical fitness, organizing meaningful leisure time, promoting a healthy lifestyle [11, 12]. The SMPEs successfully combine the developmental function, in particular, they contribute to increasing the level of physical fitness of cadets, strengthening their health, and the educational function – they provide an opportunity to organize the leisure time of personnel. A more prepared personality of the cadet is formed in matters of a healthy lifestyle and sports training due to cadets' engagement in SMPEs. Cadets' participation in SMPEs gives them positive experience that they can successfully use in their further professional activities and pass it on to their subordinates in the future. SMPEs are an effective means of educating

cadets to strive for victory and resilience in conditions of increased physical and mental stress [13, 14]. As a rule, the SMPEs in HMEIs include training sessions in sports clubs of 10-15 different sports. At the same time, the comparative analysis of the health-improving effect of engagement in various sports during the hours of SMPEs in the HMEI is the least researched.

## AIM

The aim is to investigate the impact of various sports on the level of physical health of cadets of HMEIs.

## MATERIALS AND METHODS

113 cadets of the Military Academy (Odesa) took part in the research, which was conducted in 2017-2021. The cadets of interest attended the sports clubs of the military educational institution during the hours of sporting and mass participation events in various sports: competitive sports (football, basketball, volleyball; Group 1, n=27), all-around military sports (all-around military sports complex, military pentathlon, sports orienteering; Group 2, n=16), strength sports (arm wrestling, powerlifting, tug-of-war; Group 3, n=23), martial arts (hand-to-hand combat, boxing, judo; Group 4, n=26), strength endurance (kettlebell lifting, crossfit; Group 5, n=21). Training in all sports was conducted 3 times a week for 2 hours each under the guidance of experienced coaches from the specified sports. The duration of the research was 4 years (from the first (2017) to the fourth (2021) instructional years).

**Table 1.** Dynamics of morphological and functional indicators of the HMEI cadets who were engaged in various sports during the hours of SMPEs (Mean±SD, n=113)

Stages of the research	Studied groups				
	Group 1 (n=27)	Group 2 (n=16)	Group 3 (n=23)	Group 4 (n=26)	Group 5 (n=21)
Body length, cm					
Beginning	176.4±1.07	176.9±1.34	176.2±1.13	176.5±1.09	176.7±1.19
End	177.3±1.11	177.6±1.41	176.8±1.17	177.1±1.12	177.5±1.20
Body mass, kg					
Beginning	72.9±1.29	71.4±1.54	73.1±1.33	72.5±1.19	72.6±1.36
End	73.1±1.35	70.6±1.48	74.4±1.39	73.7±1.24	72.8±1.40
Vital lung capacity, ml					
Beginning	4134.7±97.21	4206.2±104.57	4115.3±98.86	4127.2±94.37	4158.5±105.20
End	4592.1±99.46**	4725.4±98.28**	4436.9±102.13*	4511.7±97.48*	4629.6±106.74**
Hand dynamometry, kg					
Beginning	40.9±1.66	41.2±1.83	41.7±1.72	41.0±1.63	42.3±1.75
End	45.7±1.69*	46.5±1.88*	52.5±1.69***	49.6±1.62***	51.9±1.69***
Heart rate at rest, beats/min					
Beginning	69.4±0.87	69.1±0.92	69.6±0.79	69.3±0.85	69.0±0.91
End	70.1±0.89	66.7±0.85	71.4±0.83	70.7±0.91	67.5±0.82
Systolic blood pressure at rest, mm Hg					
Beginning	120.5±0.65	120.6±0.59	121.1±0.62	120.7±0.68	120.2±0.58
End	120.7±0.67	118.4±0.55	121.8±0.66	121.5±0.69	119.8±0.56

Note: Mean – arithmetical average; SD – standard deviation; \*, \*\*, \*\*\* – the significance of the difference between the cadets' indicators at the beginning and the end of the research, according to Student's t-test at  $p < 0.05$ ,  $p < 0.01$ ,  $p < 0.001$  respectively

The level of cadets' physical health was assessed according to the method of H.L. Apanasenko, which involved the determination of morphological (body length, body mass, vital lung capacity, hand dynamometry) and functional (heart rate, blood pressure) indicators. The level of physical health was determined according to the following indices subsequent to the results of their assessment: body mass index, vital index, strength index, Robinson index, time to restore heart rate after 20 squats for 30 seconds [15]. During the research, the authenticity of the difference between the studied indicators of students employing Student's t-test was determined.

## RESULTS

Table 1 shows the dynamics of morphological and functional indicators of the HMEI cadets who engaged in various sports during the hours of sporting and mass participation events. The analysis of body length indicators showed that there was no significant difference between the representatives of various sports, both at the beginning and at the end of the research ( $p > 0.05$ ). Body mass indicators also did not reliably differ between cadets of different sports clubs at the beginning of the research. During the research, there were certain changes in the body mass of the cadets, which are, in general, natural during their engagement in certain types of sports. Thus, the cadets engaged in strength sports, revealed an increase in body mass by 1.3 kg, the representatives of martial arts – by 1.2 kg, and the cadets engaged in all-around sports showed a decrease in body mass by 0.8 kg. The representatives of competitive sports and strength endurance sports revealed practically no change in their mass indicators. All detected changes were unreliable ( $p > 0.05$ ), which indicates a positive effect of any kind of sport taking into account certain peculiarities to maintain this important health indicator within the normal range.

Sports such as all-around, orienteering, kettlebell lifting, crossfit and competitive sports have the greatest influence on the indicators of the respiratory system. The cadets' indicators, who during their training were engaged in these sports, in terms of lung capacity significantly ( $p < 0.01$ ) improved by 457.4 ml (in group 1), 519.2 ml (in group 2) and 471.1 ml (in group 5), respectively. The cadets' indicators who were engaged in strength sports (group 3) and martial arts (group 4) in terms of lung capacity also improved, but the increase in the results is somewhat smaller than in groups 1, 2 and 5. No reliable difference between the indicators of lung capacity among all the studied groups of cadets were detected ( $p > 0.05$ ) at the end of the research. Assessment of the cadets' strength indicators according to the results of hand dynamometry showed that there was a significant ( $p < 0.05-0.001$ ) improvement of this indicator in all groups, but the greatest effect was found owing to strength sports, strength endurance and martial arts engagement. The rate of growth is the largest and amounts to 10.8 kg, 9.6 kg and 8.6 kg, respectively, among the cadets of these groups. The representatives of groups 3 and 5 had significantly better

strength indicators, compared to groups 1 and 2 at the end of the experiment. The highest value of hand dynamometry indicators was found in the cadets who were engaged in arm sports and powerlifting (52.5 kg). Based on the indicators of heart rate and blood pressure at rest, it can be determined that no significant difference between the indicators of the groups was found ( $p > 0.05$ ) both at the beginning and at the end of the research. The groups of cadets who were involved in all-around and endurance sports revealed some improvement in the functional capabilities of the cardiovascular system, but the indicators did not change reliably ( $p > 0.05$ ) during the research.

The results of the research of the influence of various types of sports on the physical health indicators of HMEI cadets are shown in Table 2. The body mass index of cadets of groups 1, 2, 5 improved in the process of studying in the HMEI by 0.13, 0.44 and 0.16 kg/m<sup>2</sup>, respectively. It slightly worsened in groups 3 and 4 taking into account the specifics of sports but no significant difference between the indicators at the beginning and at the end of the experiment was found. The vital index improved in all groups during the research, but a significant increase was found in all groups ( $p < 0.05-0.01$ ), except for group 3 ( $p > 0.05$ ). At the same time, the group of cadets engaged in all around sports showed the value of the vital index (66.93 ml/kg) as the best among all groups at the end of the research and it was significantly ( $p < 0.05$ ) better than in groups 3 and 4 by 7.30 ml/kg and 5.72 ml/kg, respectively.

The analysis of the strength index showed that no significant difference was found between the indicators of all groups of cadets ( $p > 0.05$ ) at the beginning of the research, and the highest value was found in group 5 (71.29%) at the end of the research. This value is significantly better than that of groups 1 and 2 ( $p < 0.05$ ), and almost the same as that of groups 3 and 4, which indicates the effectiveness of strength and power endurance sports in terms of the cadets' muscular system strengthening. According to the results of the dynamics of the Robinson index, it can be concluded that there was an improvement in the indicators in groups 2 and 5, and there was an unreliable deterioration ( $p > 0.05$ ) in groups 1, 3 and 4. However, if there was no significant difference between the indicators of all groups at the beginning of the research, then the value of the Robinson index was the best (78.97 c.u.) in group 2 at the end of the research, and it turned out to be significantly better than in groups 1, 3 and 4 ( $p < 0.05$ ). No significant difference was found between groups 2 and 5. This proves that engagement in endurance sports are the most effective in improving the activity of cadets' cardiovascular system. The indicators characterizing the duration of recovery processes of the cadets' body during the research improved significantly ( $p < 0.001$ ) in all groups. The highest values were found in groups 2 and 5 at the end of the research, while they were not significantly different from each other ( $p > 0.05$ ). Group 2 revealed significantly better indicators than all other groups except group 5. This confirms our previous findings that endurance sports have the greatest impact

**Table 2.** Dynamics of physical health indicators of the HMEI cadets who were engaged in various sports during the hours of SMPEs (Mean±SD, n=113)

Stages of the research	Studied groups				
	Group1 (n=27)	Group2 (n=16)	Group3 (n=23)	Group4 (n=26)	Group5 (n=21)
Body mass index, kg/m <sup>2</sup>					
Beginning	23.39±0.34	22.82±0.51	23.35±0.42	23.27±0.39	23.24±0.47
End	23.26±0.29	22.38±0.55	23.81±0.38	23.50±0.41	23.08±0.43
Vital index, ml/kg					
Beginning	56.71±1.57	58.91±1.81	56.37±1.64	56.89±1.49	57.65±1.72
End	62.82±1.62*	66.93±1.76**	59.63±1.70	61.21±1.53*	63.59±1.68*
Strength index, %					
Beginning	56.12±1.86	57.68±2.04	57.02±1.91	56.59±1.97	58.25±1.95
End	62.54±1.93*	65.90±2.11*	70.61±1.88***	67.33±2.01**	71.29±1.90***
Robinson index, c.u.					
Beginning	83.22±1.49	83.33±1.68	84.28±1.52	83.64±1.55	82.93±1.47
End	84.61±1.53	78.97±1.62	85.96±1.57	85.90±1.59	80.86±1.44
Time to restore heart rate, s					
Beginning	129.5±3.89	133.7±4.11	134.3±3.76	131.8±3.81	128.9±3.84
End	107.1±3.53***	98.4±3.92***	114.7±3.85***	112.5±3.88***	101.3±3.72***
Level of cadets' physical health, points					
Beginning	6.98±0.57	7.12±0.63	6.96±0.54	7.03±0.50	7.10±0.47
End	9.77±0.52**	12.34±0.52***	10.02±0.56***	10.55±0.48***	12.11±0.51***

Note: Mean – arithmetical average; SD – standard deviation; \*, \*\*, \*\*\* – the significance of the difference between the cadets' indicators at the beginning and the end of the research, according to Student's t-test at  $p < 0.05$ ,  $p < 0.01$ ,  $p < 0.001$  respectively

on health indicators. The level of cadets' physical health of all groups was reliably the same ( $p > 0.05$ ) at the beginning of the research and corresponded to the average level for men according to H.L. Apanasenko methodology. During the research, the level of health in all groups improved significantly ( $p < 0.01-0.001$ ), but the most pronounced health-improving effect was achieved owing to all-around sports and sports on the development of strength endurance. The health level was 12.34 and 12.11 points in groups 2 and 5, respectively, at the end of the research, and was assessed as above average. All other groups revealed an average level of physical health at the end of the research.

## DISCUSSION

The indicators of mortality and life expectancy, which have significantly worsened in Ukraine in recent years, are the main integral indicators of the health of the country's population. According to the research results and the indicators of average life expectancy, Ukraine is inferior not only to economically highly developed and socially prosperous European states, but also to many countries of the world with insufficient economic development [16]. The healthy life expectancy of men in Ukraine does not reach 55 years (75 years in Japan, 72 years in Austria, Great Britain, Canada, Germany, the Netherlands, 68 years in the United States of America and Cuba), which is less than even some poor Latin American countries [17]. A significant part of the population of Ukraine (at the age of 50-55) has a decline in vitality and resiliency, and the level of morbidity is increasing much earlier (by 15-

20 years) than in European countries. The situation with the health of servicemen is no better. According to the results of medical examinations, morbidity among the personnel of the Armed Forces of Ukraine develops according to the same patterns as among the civilian population. A vivid example is the data on military pensioners. The average life expectancy among those retired from the ranks of the armed forces in 1980-1989, was 63.1±3.1 years, in 1990-2000 – 54.2±1.2 years, in 2000-2010 – 50.7±2.1 years [18].

The examination of servicemen in the age of 20-35 revealed the most common risk factors for the development of such diseases (circulatory system, respiratory system, musculoskeletal system, nervous system, digestive system), which can be prevented by using an optimal mode of motor activities, tempering, rational nutrition, giving up bad habits (smoking, drinking alcohol), i.e. following the principles of a healthy lifestyle [19].

The scientists [20, 21] emphasize the ever-increasing requirements for the level of health, physical and mental preparedness of servicemen in connection with the improvement and emergence of new methods and forms of armed struggle, as well as non-contact warfare, conducting anti-terrorist operations, equipping the army with the latest types of weapons. This requires a high level of professional and physical capacity, the ability to conduct combat operations for a long time in isolation from the main forces with high physical loads. The presence of deviations from the side of health can prevent the performance of service tasks in such difficult conditions. Rational and organized motor

activities are effective means of strengthening the health of servicemen, including cadets of the Military Academy. Our research revealed that cadets' engagement in training sessions in the sport clubs of the HMEI in various sports have a positive health-improving effect on their bodies. The most pronounced health-improving effect was found in the process of physical exercises and sports that require a high level of cadets' endurance. Our research confirms the conclusions of the works of many scientists in this field [22-25] and expands them.

## CONCLUSIONS

It was established that rationally organized training sessions in the sports clubs of the military educational institution on various types of sports during the educational process have a positive health-improving effect on the cadets' body. Morphological and functional indicators, as well as the level of health of all cadets involved in the research improved. However, physical exercises and sports aimed at developing endurance and strength qualities of cadets have the greatest health-improving effect. The cadets, who during their training were engaged in all-around military sports, military pentathlon, sports orienteering, kettlebell lifting, crossfit, had the highest level of physical health characterised by 12.11-12.34 points at the end of the research. According to H.L. Apanasenko's methodology, this corresponds to an above average level of health for men. This, in turn, will contribute to increasing the resistance of their body to adverse environmental factors, compliance with the standards of a healthy lifestyle during military service and improving their working capacity during the performance of assigned tasks in the future.

*PROSPECTS FOR FURTHER RESEARCH. It is intended to investigate the dynamics of health indicators of cadets in the process of long-term strength training.*

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## Kongres Europejskich Uzdrawisk

W dniach 21-23 września 2022 r. w Pieszczanach na Słowacji odbył się 26. Kongres Europejskich Uzdrawisk. Była to okazja do omówienia sytuacji uzdrawisk w Europie i wyzwań, które stoją przed branżą oraz trendów, które pojawiły się w post-covidowej rzeczywistości. Na zaproszenie Słowackiego Stowarzyszenia Uzdrawiskowego uczestnicy przybyli do zespołu leczniczego należącego do grupy Ensana Health Spa Hotels.

Niektóre z tematów, które zostały poruszone na Kongresie ESPA, European Spas Association, to:

- prezentacje „dobrych praktyk” przez członków europejskiego stowarzyszenia,
- rosnące zapotrzebowanie na programy leczenia nowych zagrożeń jakimi jest zdrowie psychiczne oraz problem otyłości u dzieci,
- digitalizacja procesów leczniczych oraz użycie technologii rzeczywistości wirtualnej w prowadzeniu pacjentów w uzdrawiskach,
- traktowanie uzdrawisk jako elementu szerszej propozycji dla turystów odwiedzających kraje (wzajemne przenikanie się ofert i synergia),
- walka ze stereotypami dotyczącymi sanatoriów,
- specyfika rehabilitacji w kameralnych ośrodkach butikowych,
- ustawodawstwo, badania, jakość balneoterapii w nowoczesnej medycynie,
- wykorzystanie energooszczędnych innowacji, w tym odnawialnej energii, i programów finansowania remontów.

Pandemia zapoczątkowała nową erę w branży turystyki zdrowotnej, wellness i spa na całym świecie. Obecnie branża stoi w obliczu stawienia czoła nowym wyzwaniom jak kryzys energetyczny i wojna rosyjsko – ukraińska. Podczas dyskusji uznano, że ceny nośników energii muszą być regulowane w branży sanatoryjno-uzdrawiskowej, tak jak ma to miejsce w przypadku innych elementów systemu ochrony zdrowia.

„Covid zbliżał rodziny, a kryzys energetyczny może więzy rodzinne rozrywać” – powiedział Eduard Blaha, Prezes Czeskiego Stowarzyszenia Uzdrawisk, podczas konferencji prasowej dla mediów.

Janka Zalesakova, Prezes Słowackiego Stowarzyszenia Uzdrawisk, podkreśliła sukces Słowacji w opracowaniu planu leczenia powikłań pocovidowych, gdzie kluczową rolę odgrywały sanatoria. Projekt działań został przez branżę przygotowany już w październiku 2020 r., a po 6 miesiącach zaczął być konsekwentnie wdrażany. Zidentyfikowano 5 obszarów powikłań zdrowotnych, których leczenie było w pełni refundowane.

Janka Zalesakova dodała, że słowacka branża uzdrawiskowa otrzymała wsparcie w wysokości 10 mln euro podczas pandemii Covidu. Wyraziła oczekiwanie, że tamte doświadczenia zarządzania kryzysowego zostaną wykorzystane przy



zbliżającym się kryzysie związanym z gwałtownym wzrostem cen energii.

Vaclav Mika, dyrektor SLOVAKIA TRAVEL, podkreślił działania w ramach Grupy Wyszehradzkiej nakierowane na wspólnie prezentowanie swojej oferty w ramach strategii „discover Central Europe”. Zrealizowano już programy promocyjne w Izraelu, a obecnie szykowana jest akcja w niemieckim Monachium, która w spójny sposób przedstawi możliwości kontaktów między podmiotami biznesowymi (B2B) oraz przeprowadzania konferencji, zjazdów i eventów (MICE) z wykorzystaniem potencjału bazy uzdrawiskowej czterech krajów. Szczególnie miejsce zajmie komunikowanie bezpieczeństwa państw V4 pomimo toczącej się na wschodzie kontynentu wojny.

Według słowackich gospodarzy Kongresu ubytek gości z Rosji i Ukrainy udało się po części zrekomensować wzrostem zainteresowania ze strony kuracjuszy z Izraela i Półwyspu Arabskiego.

Podczas dyskusji zwrócono uwagę na rozdźwięk między prawodawstwem, a praktyczną implementacją działań związanych z możliwością transgranicznego leczenia sanatoryjnego. Dyrektywa Unii Europejskiej określa możliwości leczenia zagranicą (dofinansowanie na poziomie leczenia w reżimie krajowym) lecz przypadki uzyskania zwrotu kosztów leczenia są wciąż nieliczne, ze względu na brak wypracowanych praktycznych procesów uzyskiwania refundacji.

Uczestnicy Kongresu, w ramach działań towarzyszących wydarzeniu, mogli odwiedzić niedalekie uzdrawiska. Z 26 słowackich ośrodków do wizytacji zakwalifikowano Bojnice i Trencanské Teplice. Pierwszy dzień obrad był także okazją do świętowania jubileuszu 100-lecia Słowackiego i Czeskiego Stowarzyszenia Uzdrawiskowego.

Podsumowując obrady Kongresu zgodzono się, że Europa z wielką tradycją medycyny uzdrawiskowej i wspaniałą infrastrukturą jest rozpoznawalnym kierunkiem o wielkim potencjale zarówno obecnie, jak i w przyszłości. Uczestnicy Kongresu Europejskich Uzdrawisk podzielili się doświadczeniami i szykują do nadchodzących wyzwań. (kk)