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- Assessment of Physical Therapy Following Knee Arthroplasty
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# Assessment of Physical Therapy Following Knee Arthroplasty

## Analiza postępowania fizykalnego po endoprotezoplastyce stawu kolanowego

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### SUMMARY

**Aim:** The aim of the study was to assess the quality of life and physical therapy used in patients after knee arthroplasty.**Materials and Methods:** The study involved 20 patients after surgical treatment with knee arthroplasty staying at the in-patient rehabilitation centre in Osieczek. The patients underwent physical therapy and rehabilitation.**Results:** Following 3-week treatment, study patients showed better mobility, pain elimination and an improved quality of life. Further management included recommendations with respect to regular physical activity and maintaining a normal body weight.**Conclusions:** 1. Osteoarthritis is the most common cause of disability in patients.

2. Arthroplasty has a beneficial influence on the subjective and objective condition of patients. 3. The procedure helped increase mobility, improved the quality of life and eliminated pain in the patients. 4. Regular physical activity and a normal body weight play an important role in osteoarthritis prevention.

**Key words:** osteoarthritis, arthroplasty, physical therapy and rehabilitation**Słowa kluczowe:** choroba zwyrodnieniowa stawów, endoprotezoplastyka, postępowanie fizykalno-usprawniające

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### INTRODUCTION

Osteoarthritis (OA) is the most common cause of disability in humans. The incidence of OA is 7-14% in people aged 45 to 49 years; in people aged 55 to 64 years, OA affects up to 30% of men and 40% of women. OA is associated with a reduced quality of life and a high disability index; consequently, it is becoming the main cause of functional limitations in the elderly. Aging societies and an increased obesity rate result in a higher prevalence of OA. The disorder affects as many as 80% of people over the age of 75 years. In the United States, OA affects 33 million adults [1-5].

OA is a chronic condition characterised by articular cartilage damage. Patients diagnosed with knee OA experience pain that intensifies during walking, impaired muscle and ligament stability and, consequently, knee instability and reduced knee joint mobility resulting from articular surface damage. All these changes reduce the effectiveness of locomotion and statics in OA patients [6-13].

Impaired articular cartilage homeostasis in the joints is believed to be the main factor of knee OA development. It occurs when the activity of degradative enzymes outweighs

the activity of regenerative factors. The connection between OA and genetic factors has also been confirmed [1, 7].

OA is characterised by the constant progression of pathological changes. Patients with non-advanced OA may undergo conservative treatment; unfortunately, it is believed that the advanced stage of the disorder requires surgery in the form of total knee replacement. In the US, 581,000 knee arthroplasty procedures are conducted every year. The majority of those procedures are performed in people aged 60 to 80 years [11, 13].

Conservative management and prevention (weight loss and limiting the type of physical activity that strains the joints) are helpful in non-advanced OA. Physical therapy in OA is based on physiotherapy, massage and kinesiotherapy, which largely prevents the development of muscle atrophy, contractures or joint deformities [14-18].

Conservative OA treatment includes the following physiotherapy methods: laser therapy, cryotherapy, electrotherapy, ultrasound therapy and shockwave therapy [17-25].

Knee arthroplasty is the only effective method of surgical treatment in advanced joint changes. OA patients may undergo

total knee replacement or partial (unicompartmental) knee replacement. Endoprostheses are also divided based on the type of fixation to the bone (cemented and cementless). Cemented implants are more popular.

Pain is believed to be the main indication for knee arthroplasty. The endoprosthesis may be implanted on condition that the patient has an appropriate degree of bone calcification and bone structure resistance in the region that will support the implant, particularly in the subchondral layer of the tibial condyle [11, 13].

Arthroplasty should always be followed by rehabilitation. Rehabilitation should be tailored to the patient's needs, age, work, physical activity and comorbidities. When selecting appropriate rehabilitation methods, it is important to consider the surgical technique, implant fixation method and condition of the bone tissue. The rehabilitation process consists of two main phases: the preparatory preoperative phase and the postoperative rehabilitation phase. The preoperative preparation (mental and physical) helps achieve a better treatment outcome.

After arthroplasty, the patient should be hospitalised for at least five or six days. During the stay, the patient should be instructed on what activities to avoid in the first weeks after surgery. While the patient is hospitalised, the rehabilitation is aimed at achieving maximum restoration of operated joint mobility (0–90° of flexion) and at gradually increasing muscle strength (isometric exercises for the quadriceps femoris, gluteus muscles and ischio-crural muscles). In addition, the patient may undergo gait training using a walking frame or elbow crutches. Preventing oedema and thrombosis is crucial in postoperative management, including cooling and elevation of the limb and exercises to improve circulation [15, 16, 19].

Posthospital rehabilitation is focused mainly on continuing the exercises introduced during the hospital stay and on adding other kinesiotherapy procedures (active exercises of the foot, isometric exercises of the knee to achieve a better axial alignment and to prevent knee valgus). As far as physiotherapy is concerned, the cryotherapy and laser therapy used in the preoperative period should be continued. This rehabilitation period is used to increase strength, range of mobility and muscular endurance, reduce oedema or inflammation and improve the patient's fitness after surgery. The next phase is the period between 4 and 12 weeks after surgery, when the patients return to their normal activity [23-25].

**AIM**

The aim of the study was to assess the quality of life and physical therapy used in patients after knee arthroplasty.

**MATERIALS AND METHODS**

The study involved patients staying at the in-patient rehabilitation centre in Osieczek.

The study group consisted of 20 patients, including 12 women (60%) and 8 men (40%). The age of the patients ranged from under 50 years to over 80 years (Figure 1).

The patients underwent a three-week rehabilitation programme, during which they received physical therapy and rehabilitation.

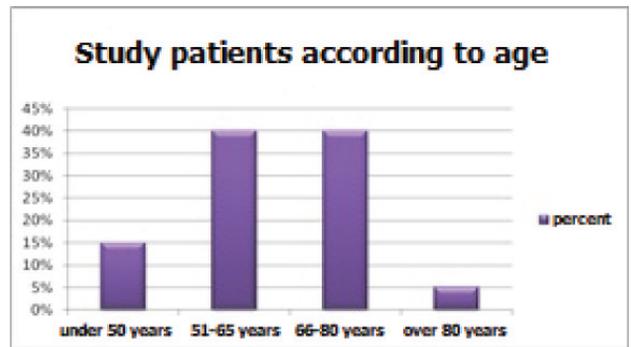


Figure 1. Study patients according to age

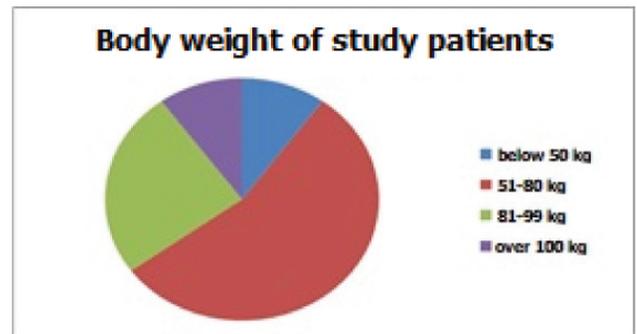


Figure 2. Study patients according to body weight

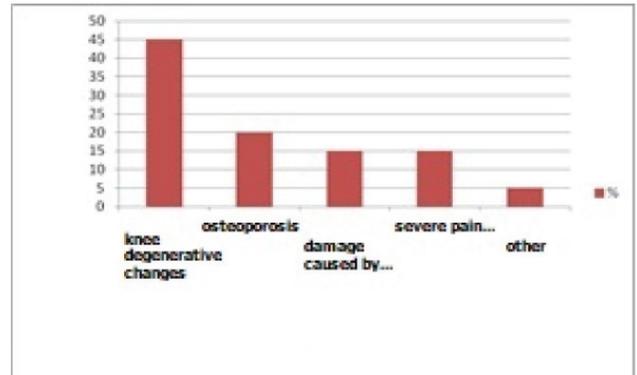


Figure 3. Study patients according to reasons for conducting arthroplasty

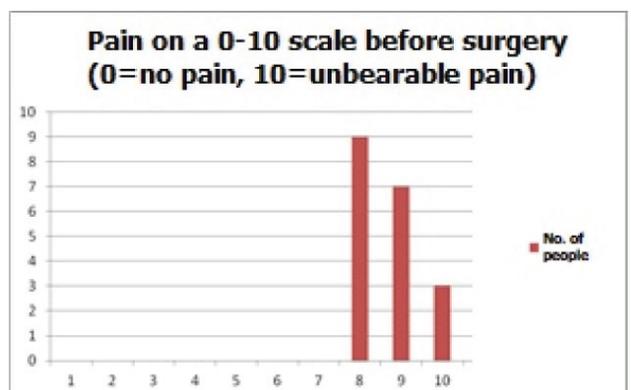


Figure 4. Pain assessment on a 0–10 scale before surgery

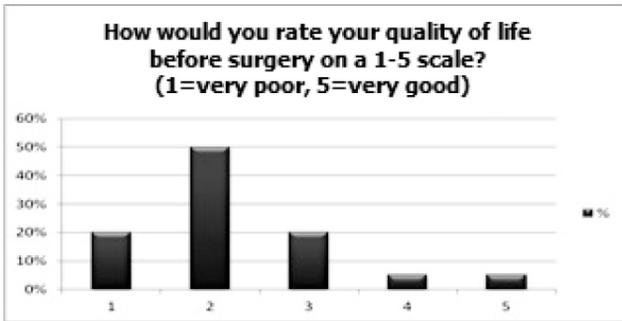


Figure 5. Assessment of quality of life before surgery

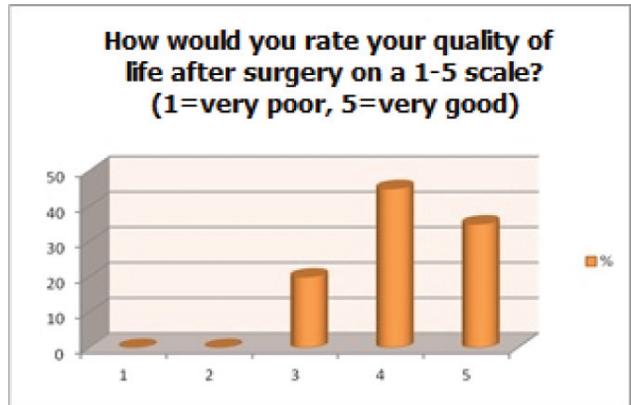


Figure 9. Assessment of quality of life after surgery on a scale from 1 to 5

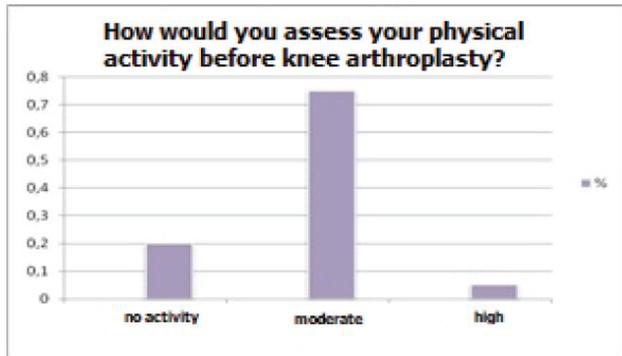


Figure 6. Assessment of physical activity before surgery

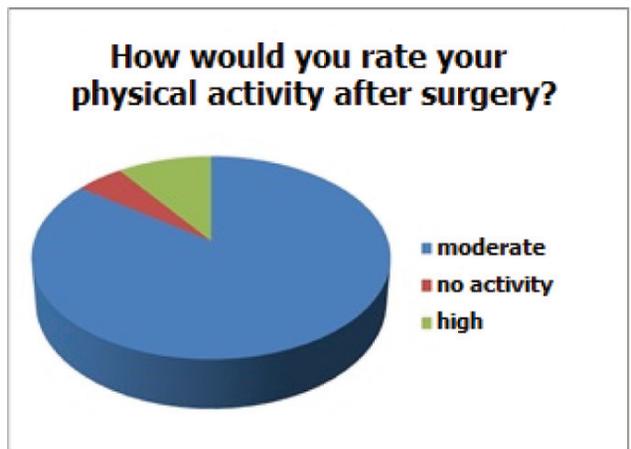


Figure 10. Assessment of physical activity after surgery

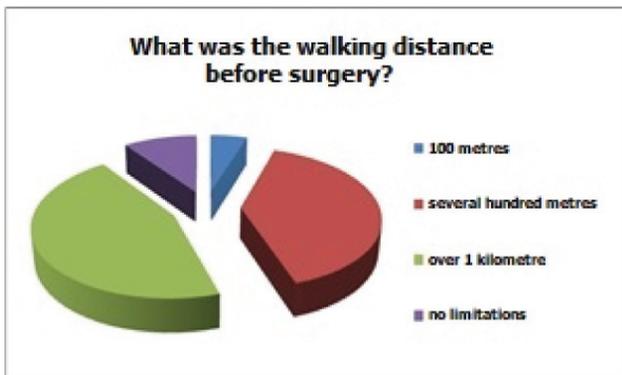


Figure 7. Walking distance before surgery



Figure 11. Walking distance after arthroplasty

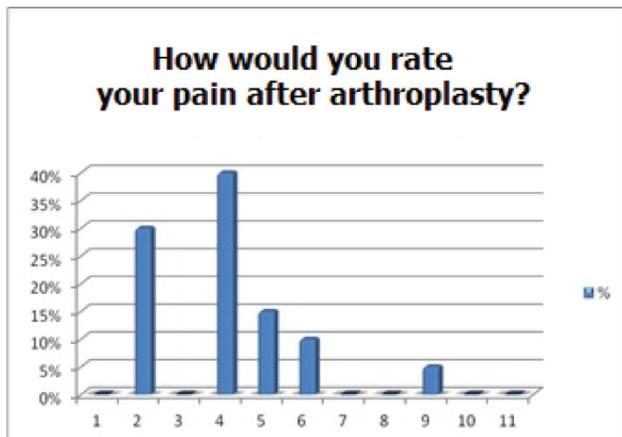


Figure 8. Assessment of pain after knee arthroplasty

The results of post-treatment assessments of the patients' subjective (survey) and objective condition were statistically analysed.

## RESULTS

The figure 2 shows study patients divided according to their body weight. 11 study patients (55%) indicated that their height was between 151 cm and 170 cm, 7 patients (35%) chose the 171-190 cm answer and 2 patients (10%) were taller than 191 cm.

**Table 1.** Assessment of physical activity before and after surgery

|                | No activity |     | Moderate level of activity |     | High level of activity |     | Total |
|----------------|-------------|-----|----------------------------|-----|------------------------|-----|-------|
|                | N           | %   | N                          | %   | N                      | %   | N     |
| Before surgery | 4           | 20% | 15                         | 75% | 1                      | 5%  | 20    |
| After surgery  | 1           | 5%  | 17                         | 85% | 2                      | 10% | 20    |
| Total          | 5           |     | 32                         |     | 3                      |     | 40    |

The next question concerned the place of residence. 8 study patients (40%) lived in a town with a population below 50 000 people, 5 study patients (25%) lived in a town with a population of 50,000 to 100 000 people and another 5 patients (25%) lived in a city with a population of over 100 000 people. The other 2 patients (10%) lived in a rural area.

35% of study patients were manual workers, 30% were intellectual workers, 20% were pensioners or were drawing a disability pension and the other 15% did not work.

40% of study patients underwent knee arthroplasty 1 to 2 years before the study, 30% were operated on 3 to 4 years before the study and 25% less than 1 year before the study. The other 5% of study patients underwent the surgery more than 5 years before the study.

Reasons for conducting arthroplasty in study patients are, shown in the figure 3. When asked if they had received preoperative rehabilitation, 65% of study patients answered "yes" and the other 35% answered "no". The figure 4 presents pain assessment before the knee arthroplasty procedure.

20% of study patients received bilateral prostheses. The figure 5 presents the results of a quality of life assessment before the knee arthroplasty procedure. The figure 6 presents the patients' assessment of the level of their own physical activity before arthroplasty. 75% (15 study patients) described their level of physical activity as moderate and 5% described it as high. 20% of study patients reported no physical activity.

The figure 7 shows the patients' assessment of their pain-free walking distance before surgery. Using stairs was difficult for 75% of study patients while 25% of study patients did not have such difficulties. Before surgery, 65% of study patients found it difficult to work due to pain.

Another question focused on how much time had passed between the surgery and the start of rehabilitation. Most patients started rehabilitation immediately after the arthroplasty procedure (breathing exercises, exercises in a horizontal position, passive exercises).

Next, study patients rated their pain after knee arthroplasty on a scale from 0 to 10 (where 0 = no pain and 10 = unbearable

pain). The answers were as follows: 40% described their pain as 4, 30% as 2, 15% as 5 (Figure 8).

Another question concerned an assessment of the quality of life after knee arthroplasty on a scale from 1 to 5 (where 1 = very poor and 5 = very good). The results were as follows: 45% of study patients rated their quality of life as 4, 35% as 5 and 20% as 3. No patients selected the answers 1 or 2 (Figure 9).

Study patients also assessed their physical activity after knee arthroplasty. The majority (85%) reported a moderate level of physical activity, 10% a high level of physical activity and 5% selected the "no activity" answer (Figure 10).

The next question focused on whether study patients experienced difficulty with using stairs after surgery. As many as 75% of study patients answered "no" while 25% continued to have difficulty using stairs.

Study patients were also asked if they experienced difficulty at work after knee arthroplasty: 90% did not complain of any problems and 10% continued to experience problems at work.

The figure 11 shows the walking distance after surgery. No limitations were reported by 50% of study patients, a distance of over one kilometre was reported by 30% of study patients, a distance of several hundred metres was reported by 20% and no patients selected the "100 metres" answer.

The data from the figures and from the table 1 allow for concluding that the level of physical activity in study patients improved after knee arthroplasty. A chi-squared ( $\chi^2$ ) test was performed and showed statistical significance. The strength of correlation according to Guilford's scale was high.

Based on those calculations, one can conclude that the  $\chi^2$  result is statistically significant, the significance level is 0.001 and the strength of correlation ( $r_c r_c$ ) is 0.76, which is interpreted as high. The strength of correlation was calculated with the following formula:

$$r_c r_c = \frac{\sqrt{\chi^2}}{(\chi^2 + n)} \frac{\sqrt{\chi^2}}{(\chi^2 + n)}$$

where n = total number of people participating in the study.

**Table 2.** Comparison of pain intensity before versus after knee arthroplasty

| Pain score | 1 | %  | 3 | %  | 4 | %  | 5 | %  | 7 | %  | 8 | %  | 9 | %  | 10 | % | total |
|------------|---|----|---|----|---|----|---|----|---|----|---|----|---|----|----|---|-------|
| Before     | 0 | 0  | 0 | 0  | 0 | 0  | 0 | 0  | 9 | 45 | 7 | 35 | 3 | 15 | 1  | 5 | 20    |
| After      | 6 | 30 | 8 | 40 | 3 | 15 | 2 | 10 | 0 | 0  | 1 | 5  | 0 | 0  | 0  | 0 | 20    |
| Total      | 6 | 30 | 8 | 40 | 3 | 15 | 2 | 10 | 9 | 45 | 7 | 40 | 3 | 15 | 1  | 5 | 40    |

**Table 3.** Comparison of quality of life before versus after knee arthroplasty

| Quality of life | 1 | %   | 2  | %   | 3 | %   | 4  | %   | 5 | %   | Total |
|-----------------|---|-----|----|-----|---|-----|----|-----|---|-----|-------|
| Before          | 4 | 20% | 10 | 50% | 4 | 20% | 1  | 5%  | 1 | 5%  | 20    |
| After           | 0 | 0   | 0  | 0   | 4 | 20% | 9  | 45% | 7 | 35% | 20    |
| Total           | 4 | 20% | 10 | 50% | 8 | 40% | 10 | 50% | 8 | 40% | 40    |

**Table 4.** Assessment of walking distance before and after surgery

| Walking distance | 100 metres |    | Several hundred metres |     | More than 1 km |     | No limitations |     |
|------------------|------------|----|------------------------|-----|----------------|-----|----------------|-----|
|                  | N          | %  | N                      | %   | N              | %   | N              | %   |
| Before           | 1          | 5% | 8                      | 40% | 9              | 45% | 2              | 10% |
| After            | 0          | 0% | 4                      | 20% | 6              | 30% | 10             | 50% |
| Total            | 1          | 5% | 12                     | 60% | 15             | 75% | 12             | 60% |

The study showed that pain intensity after surgery was considerably lower than before the procedure (Table 2). As with the previous table, a chi-squared test was used. Once the theoretical values had been calculated, the value for  $\chi^2$  was determined, which is

$$\chi^2 = 37.1 > \chi^2 = 36.123$$

This result was found to be statistically significant; the degree of freedom was 14. Next, the strength of correlation was calculated, whose value turned out to be 0.8, meaning that the correlation of the above pain values was very high.

The  $\chi^2$  value for the table 3 was  $\chi^2 = 18.4$  and the degree of freedom was 10. Chi-squared tables showed that this result was closest to 0.05, which means that the correlation was statistically significant. The strength of correlation ( $r_{ic}$ ,  $r_{ic}$ ) was then assessed and turned out to be 0.7. This result suggests that the strength of correlation between the values before and after the surgery is very high.

Based on the table 3, one can conclude that the quality of life in study patients considerably improved after knee arthroplasty. All study patients rated their current quality of life as over 3 (no one selected a lower answer). In contrast, few patients selected answers 4 and 5 before the procedure.

Before arthroplasty, most study patients experienced limitations with respect to walking longer distances, with only 2 people not complaining of any limitations. After arthroplasty, as many as 10 study patients did not have any limitations and 6 study patients were able to walk over 1 kilometre (Table 4). This shows that knee arthroplasty increased study patients' mobility.

The table 4 for the walking distance before and after surgery was used to perform a chi-squared test. After calculating boundary values (F), it was possible to calculate the  $\chi^2$  value ( $\chi^2=61.05$ ). Next, the degree of freedom was calculated to be 8. It is not possible to determine the probability of correlation for these values.

Based on the table 5, one can conclude that the surgery made it easier for study patients to work. A considerable part of the study group experienced significant pain at work before surgery (13 patients); 7 patients did not complain of any difficulty at work. After surgery, 18 study patients did not experience pain at work while the other 2 patients still complained of pain.

After calculating boundary values (F) for the last table, it was possible to perform a chi-squared test.

**Table 5.** Comparison of difficulty at work before versus after surgery

| Difficulty at work | Yes |     | No |      |
|--------------------|-----|-----|----|------|
|                    | N   | %   | N  | %    |
| Before surgery     | 13  | 65% | 7  | 35%  |
| After surgery      | 2   | 10% | 18 | 90%  |
| Total              | 15  | 75% | 25 | 125% |

$$\chi^2 = 26.52 > \chi^2 = 13.465 \text{ for the empirical value of } 0.001.$$

The above indicates that the correlation is statistically significant. The degree of freedom in this case is 4. The strength calculated for this correlation was  $r = 0.4$ . In the corresponding table, this value indicates a moderate strength of correlation.

## DISCUSSION

Knee arthroplasty is becoming an increasingly common surgical procedure in knee osteoarthritis. Knee OA leads to gradual destruction of the joint, increasing pain and limited mobility, eventually resulting in a considerably decreased quality of life. Most patients affected by this are elderly people.

The study was conducted in patients after knee arthroplasty treated at the in-patient rehabilitation centre in Osieczek. The length of the stay was 3 weeks. Study patients underwent targeted physical therapy and rehabilitation. Moreover, during their stay at the centre the patients met with a psychologist.

The majority of study patients did not receive physical therapy before the surgery; after the surgery, all study patients underwent physical therapy procedures and rehabilitating exercises. More than 65% of study patients started rehabilitation very early, with some patients starting rehabilitation before the arthroplasty procedure (breathing exercises, postural positions).

Most study patients assessed in this study were female. This confirms that osteoarthritis affects more women than men. Moreover, the majority of study patients were women who were manual workers.

The majority of patients were aged between 51 and 80 years, which means they were at a considerably higher risk of osteoarthritis than individuals under the age of 50 years. Consequently, osteoarthritis prevention is largely focused on regular physical activity, a balanced diet that helps maintain a normal body weight, avoiding joint overload and good posture.

OA patients should also prevent pain at an earlier stage of the disorder with the use of conservative treatment. Rehabilitation is necessary to minimise the need for pharmacotherapy. Unfortunately, most study patients did not receive physical therapy prior to the arthroplasty procedure, which resulted in the procedure being performed considerably earlier. Systematic exercise is crucial in order to maintain a high quality of life. Patients after arthroplasty have to constantly make an effort to maintain normal muscle strength both in the lower limbs and in the entire body.

Arthroplasty improved gait in a considerable number of study patients, who became able to walk far longer distances than before the surgery. Moreover, after the procedure, study patients did not face limitations at work due to pain, even though many of them had experienced pain at work before the surgery. The results of pain and quality of life assessments were also markedly better than before the procedure. Knee arthroplasty constitutes a method of choice, is effective and improves the patient's functioning; however, conservative treatment should be used more often as it can considerably delay the need for surgery and improve the quality of life.

## CONCLUSIONS

Osteoarthritis is the most common cause of disability in patients.

Arthroplasty has a beneficial influence on the subjective and objective condition of patients.

The procedure helped increase mobility, improved the quality of life and eliminated pain in the patients.

Regular physical activity and a normal body weight play an important role in osteoarthritis prevention.

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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

# Rehabilitation in Post COVID-19 Neurological Syndrome

## Rehabilitacja w zespole neurologicznym po przechorowaniu COVID-19

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### SUMMARY

**Aim:** Was a study of the role of neuroprotection therapy in rehabilitation possible neurological manifestations of post-COVID-19 syndrome and its effect on productivity in post-COVID-19 patients.

**Materials and Methods:** All patients underwent neuropsychological testing immediately after the COVID-19 treatment and after the administration of neuroprotection therapy.

**Results:** All patients voiced complaints typical of asthenic syndrome. Upon the neuroprotection, a verified ( $p < 0,01$ ) increase in well-being, activity and mood in both the Test groups was observed. Significantly, in the Test group 1 showed verified ( $p < 0,01$ ) increase in all indicators after the neuroprotection course, compared with the Test group 2 upon the implementation of a rehabilitation program only. Upon the neuroprotection and comprehensive rehabilitation program, both the test groups and the control group proved a decrease in the signs of asthenic syndrome, with Test groups 1 and 2 displayed verified effect ( $p < 0,01$ ). Both, upon neuroprotection and upon the four-week rehabilitation program, the following verified positive changes in the level of severity of asthenic syndrome were observed.

**Conclusions:** Early administration of neuroprotection able maliorating neurological manifestations of post-COVID-19 syndrome, reducing recovery time and enhancing productivity in post-COVID-19 patients.

**Key words:** neuroprotection therapy, rehabilitation, post-COVID-19 neurological syndrome, productivity

**Słowa kluczowe:** terapia neuroprotekcynna, rehabilitacja, zespół neurologiczny po COVID-19, produktywność

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### INTRODUCTION

The number of post-COVID-19 sufferer's in the world at present amounts to almost 265 million [1]. However, it should be kept in mind that the sufferer's ordinal and send once a PCR test shown a negative results. It is estimated that the incidence of post-COVID-19 effects in outpatients ranges between 10% and 35%, while with inpatients these may reach up to 80% [2]. Post-COVID-19-syndrome also known as long COVID involves average of complication of coronavirus infection by which up to 20% of the sufferer's experience long-term symptoms lasting up to 12 weeks and 2,3% cases even longer. This term "Post-COVID-19-condition" has been included in the International Classification of Diseases ICD-10 [3]. Recently, Post-COVID-19 Neurological Syndrome (PCNS) has been receiving and ever wider coverage [4]. The manifestations of PCNS include deterioration in pre-existing cognitive impairment, persistent fatigue, diffuse myalgia, emotional impairment, depressive symptoms, and sleeping disorders [5-7].

Such signs are characteristic of the syndrome of chronic fatigue, which is a long-term manifestation of asthenic syndrome, which may be a long term effect of neuroimmune exhaustion after a viral load [8].

The pathogenesis of post-COVID syndrome is multifactorial with prolonged inflammation account for some cognitive dysfunction, neurological complications, and several other symptoms. Other pathogenetic mechanisms of post-COVID-19 syndrome include immune-mediated vascular disorders, thromboembolism, and nervous system dysfunction [9-11]. With take into account the multifactorial pathogenesis of PCNS, it seems advisable to administer neuroprotection therapy, aimed at reducing the overproduction of nitric oxide, oxidative stress, activation of microglia, expression of proinflammatory cytokines, local inflammation, mitochondrial dysfunction, and increasing apoptosis. The efficiency of neuroprotection has been shown in patients with acute ischemic stroke [12] and in treatment of the consequences of acute traumatic brain injury [13] etc.

High incidence of asthenic syndrome symptoms in patients with PCNS is known to lead to impaired social and economic conditionals and a marked deterioration in the patient's quality of life [14] – all requiring finding effective methods in the patient's rehabilitation.

### AIM

The aim of this study was scrutinise the effect of neuroprotection on the asthenic syndrome as a manifestation of a PCNS with a follow up assessment of its impact on productivity in post-COVID-19 patients. These objectives in view the following tasks were set: processing complaints that show signs of asthenic syndrome; establishment of the types and degree of severity of the syndrome; investigating into changes in manifestations of asthenic syndrome upon the neuroprotection and assessment its effect in terms of convalescence and productivity of post-COVID-19 patients.

### MATERIALS AND METHODS

We examined 20 post-COVID-19 patients (8 males and 12 females), aged 32 to 78, 30% of who suffered a mild form of COVID-19 (treated on an outpatient basis); 50% patients who suffered a moderate COVID-19 and 20% upon a severe form of coronavirus disease (all treated in a hospital environment). During the treatment none of the patients needed artificial ventilation of lungs; while 16 (80%) patients received oxygen inhalation using in the form either oxygen concentrators or an oxygen supply system in hospital. Following either outpatient or inpatient treatment, an assessment of the state of the nervous system was carried out in order to determine the presence and nature of the disorders. The complaints obtained, a neuropsychological testing based on the use of assessment scales was applied. To determine the psychoemotional state of patients, the questionnaire was used: self-assessment of well-being, activity and mood (WAM) [15]. The WAM table contains 30 pairs of opposing characteristics of a person's psychoemotional state. The patients were offered to mark the degree of severity of any particular characteristic of their condition. In order to determine the prevailing type of asthenic syndrome, a subjective asthenia assessment scale was applied, Multidimensional Fatigue Inventory (MFI-20) [16]. The questionnaire consists of 20

questions and provides 5 sub-scales to determine general, physical or mental asthenia, reduced activity and motivation. To determine the degree of asthenic syndrome, the L. D. Malkov questionnaire, (Asthenic State Scale, (ASS)), was used [17]. The questionnaire suggests 30 questions, with possible answers estimated from 1 to 4 points. On the results of the test, the absence of asthenia or its presence in a weak, moderate or extreme degree was assessed.

As the neuroprotection therapy, for 10 days all patients received Citicoline 2000 mg diluted to at least 200 ml total volume with Saline solution per day by IV infusion; Vinpocetine 20-50 mg diluted to at least 500 ml total volume with Saline solution per day by IV infusion; Nootropil 60 ml (12 g) per day by IV; Cerebrolysin 20 ml diluted to at least 100ml total volume with Saline solution per day by IV infusion. It should be noted that all drugs of pathogenetic action were used off-label, i.e. beyond the indications in compliance with official instructions [18]. The patients receiving neuroprotection formed Test group 1. The 22 patients of Test group 2 were offered a comprehensive rehabilitation program that included physical exercise and brain activity stimulators without neuroprotection administration. All types of exercises were selected in compliance with recommendations for rehabilitation of patients after COVID-19 issued by the WHO Regional Office for Europe [19]. The Control group embraced 12 post-COVID-19 patients aged, 32 to 74, who underwent evaluation of the nervous system state via the same questionnaire immediately after the treatment and 1 month after and who refused to perform rehabilitation program and receive neuroprotection. In addition, the duration of disability in all groups was assessed. All methods applied during the study complied with requirements of the Helsinki Declaration of the World Medical Association.

### RESULTS

During the anamnesis, all patients voiced complaints typical of asthenic syndrome. 100% patients complained about general weakness, reduced productivity and sustained fatigue. From 50% to 100% patients complained about undersleepeness upon awakening, sleeping disorders, mood swings, anxiety, impaired attention span and pour memory retention (Table 1).

**Table 1.** Distribution of the frequency of complaints among the groups of PCNS patients

| Complaints                      | Test group 1<br>(n=20) | Test group 2<br>(n=22) | Control group<br>(n=12) |
|---------------------------------|------------------------|------------------------|-------------------------|
| General weakness                | 100%                   | 100%                   | 100%                    |
| Reduced productivity            | 100%                   | 100%                   | 100%                    |
| Increased fatigue               | 100%                   | 100%                   | 100%                    |
| Undersleepeness after awakening | 85%                    | 86%                    | 83,3%                   |
| Sleeping disorder               | 60%                    | 86%                    | 66,6%                   |
| Mood swings                     | 75%                    | 72,7%                  | 58,3%                   |
| Anxiety                         | 60%                    | 72,7%                  | 58,3%                   |
| Impaired attention span         | 80%                    | 86,4%                  | 50%                     |
| Pour memory retention           | 80%                    | 86,4%                  | 50%                     |

**Table 2.** WAM test performance rates: well-being, activity and mood of PCNS patients

| Indicator<br>WAM scales | Test group 1<br>(n=20) |                              | Test group 2<br>(n=22) |                             | Control group<br>(n=12) |                             |
|-------------------------|------------------------|------------------------------|------------------------|-----------------------------|-------------------------|-----------------------------|
|                         | 1                      | 2                            | 1                      | 2                           | 1                       | 2                           |
| Well-being              | 43,21<br>±1,78         | 53,23<br>±1,34 <sup>*v</sup> | 43,55<br>±1,33         | 51,63<br>±1,47 <sup>*</sup> | 42,78<br>±1,80          | 46,38<br>±1,61 <sup>*</sup> |
| Activity                | 48,46<br>±1,2          | 58,35<br>±1,67 <sup>*v</sup> | 49,21<br>±0,97         | 55,23<br>±1,25 <sup>*</sup> | 48,33<br>±1,13          | 49,2<br>±1,28               |
| Mood                    | 41,65<br>±1,03         | 58,38<br>±1,36 <sup>*v</sup> | 42,08<br>±0,90         | 57,32<br>±1,21 <sup>*</sup> | 41,85<br>±1,10          | 48,33<br>±1,01 <sup>*</sup> |

1 – Prior to the neuroprotection or post-COVID-19 rehabilitation program

2 – Upon the neuroprotection or post-COVID-19 rehabilitation program

\* $p < 0,01$  – verified increase in WAM indicators after the neuroprotection or post-COVID-19 rehabilitation program

<sup>v</sup> $p < 0,01$  – verified increase in WAM indicators after the neuroprotection and post-COVID-19 rehabilitation program

**Table 3.** Determination of asthenic syndrome type by MFI-20 in PCNS patients

| Indicator         | Test group 1<br>(n=20) |                         | Test group 2<br>(n=22) |                        | Control group<br>(n=12) |           |
|-------------------|------------------------|-------------------------|------------------------|------------------------|-------------------------|-----------|
|                   | 1                      | 2                       | 1                      | 2                      | 1                       | 2         |
| General asthenia  | 14,47±2,59             | 7,13±3,23 <sup>*v</sup> | 16,81±3,71             | 8,47±2,47 <sup>*</sup> | 12,86±1,80              | 9,81±4,4  |
| Physical asthenia | 15,62±3,05             | 8,05±3,04 <sup>*v</sup> | 17,61±2,26             | 8,85±2,35 <sup>*</sup> | 15,43±4,16              | 9,24±3,42 |
| Mental asthenia   | 10,69±4,15             | 5,14±2,46 <sup>*</sup>  | 11,07±4,33             | 5,01±1,71 <sup>*</sup> | 10,27±4,22              | 8,73±3,06 |
| Low activity      | 15,43±4,10             | 7,87±3,32 <sup>*v</sup> | 16,9±3,61              | 10,8±2,91 <sup>*</sup> | 14,64±4,43              | 9,31±3,56 |
| Low motivation    | 10,06±4,42             | 5,18±2,01 <sup>*v</sup> | 11,1±4,73              | 5,98±1,78 <sup>*</sup> | 9,33±4,21               | 7,01±2,93 |

1 – Prior to the neuroprotection or post-COVID-19 rehabilitation program

2 – Upon the neuroprotection or post-COVID-19 rehabilitation program

\* $p < 0,01$  – verified of comparison in MFI-20 indicators after the neuroprotection or post-COVID-19 rehabilitation program

<sup>v</sup> $p < 0,01$  – verified of comparison in MFI-20 indicators after the neuroprotection and post-COVID-19 rehabilitation program

According to the WAM questionnaire, the study showed a decreased health indicators in patients of the Test groups (Table 2) with a slight down word trend with insignificant differs among the groups. Upon the neuroprotection, a verified ( $p < 0,01$ ) increase in well-being, activity and mood in both the Test groups was observed. Significantly, in the Test group 1 showed verified ( $p < 0,01$ ) increase in all indicators after the neuroprotection course, compared with the Test group 2 upon the implementation of a rehabilitation program only. The control group showed verified increasing in the well-being and mood assessment, the other indexes remained unverifiable and within the medium level.

In compliance with Multidimensional Fatigue Inventory (MFI-20), all types of asthenic syndrome, i.e. general, physical and mental asthenia, including decrease in activity and motivation, were observed in PCNS sufferers (Table 3). No verifiable difference among the groups as to the type of asthenic syndrome was revealed immediately upon the termination of treatment of coronaviral disease. Upon the neuroprotection and comprehensive rehabilitation program, both the test groups and the control group proved a decrease in the signs of asthenic syndrome, with Test groups 1 and 2 displayed verified effect ( $p < 0,01$ ). The Control group showed a trend to decrease in general, physical and mental asthenia along with increased activity and motivation, these changes however unverifiable. Significantly, all groups of patients displayed

prevalence of general and physical asthenia over mental with a marked decrease in activity. Upon the neuroprotection, a noticeable verified decrease in the manifestations of general and physical asthenia was observed, with an increased activity and motivation against the background of an insignificant physical asthenia increase in Test group 2 upon the completion of the rehabilitation program.

According to the ASS, 45-50% of PCNS patients revealed an extreme degree of asthenia; 33% of the patients were diagnosed as suffering a moderate degree of asthenia and the remaining 16.6-20% suffering a weak degree of asthenia with no significant differences verified among the groups (Table 4). No verifiable difference was established among the groups as to the degree of asthenia. Both, upon neuroprotection and upon the four-week rehabilitation program, the following verified positive changes in the level of severity of asthenic syndrome were observed. In Test groups 1 and 2, no extreme asthenic syndrome cases were observed, as opposed to the Control group, in which the extreme asthenic syndrome case was still observed in one patient. Test groups 1 and 2 showed a verified ( $p < 0,01$ ) decrease in moderate asthenic syndrome cases (from 15% to 10.5%) and a decrease in weak asthenic syndrome cases (from 40% to 34.6%). Test group 2 displayed no reduction in moderate asthenic syndrome cases after the rehabilitation program (33.4% before and 33.3% after the rehabilitation program, respectively) and a verified

**Table 4.** Asthenic syndrome severity levels on the ASS in PCNS patients

| Asthenia level                | Test group 1 (n=20) |     |                              | Test group 2 (n=22) |                |       | Control group (n=12) |        |                |        |                |        |
|-------------------------------|---------------------|-----|------------------------------|---------------------|----------------|-------|----------------------|--------|----------------|--------|----------------|--------|
|                               | 1                   | 2   |                              | 1                   | 2              |       | 1                    | 2      |                |        |                |        |
| Extreme                       | 112,26<br>±5,46     | 45% | 0*                           | 115<br>±3,31        | 46,8%          | 0*    | 112,87<br>±7,80      | 50%    | 102±<br>0,01*  | 16,6%* |                |        |
| Moderate                      | 83,45<br>±6,54      | 30% | 77,45<br>±2,71* <sup>v</sup> | 15%* <sup>v</sup>   | 85,5<br>±6,91  | 33,2% | 78,4<br>±4,52*       | 22,7%* | 81,23<br>±7,3  | 33,3%  | 79,27<br>±2,26 | 41,7%* |
| Mild                          | 67,14<br>±4,86      | 25% | 53,18<br>±2,82* <sup>v</sup> | 65%* <sup>v</sup>   | 64,08<br>±6,25 | 20%   | 57,32<br>±1,21*      | 54,6%* | 66,85<br>±5,10 | 16,6%  | 61,12<br>±6,01 | 33,4%* |
| No signs of asthenic syndrome | 0                   |     | 33<br>±1,01*                 | 20%*                | 0              |       | 32,12<br>±1,5*       | 22,7%* | 0              |        | 35<br>±0,01*   | 8,3%*  |

1 – Prior to the neuroprotection or post-COVID-19 rehabilitation program

2 – Upon the neuroprotection or post-COVID-19 rehabilitation program

\* $p < 0,01$  – verified changes asthenia level after the neuroprotection or post-COVID-19 rehabilitation program

<sup>v</sup> $p < 0,01$  – verified changes asthenia level after the neuroprotection and post-COVID-19 rehabilitation program

( $p < 0,01$ ) increase in weak asthenic syndrome cases (from 16.6% to 50.1%) with a decrease in the intensity of asthenic syndrome manifestations. In both Test groups there were patients with no signs of asthenic syndrome: 20% in the Test group 1 and 22.7% in the Test group 2. The Control group showed a verified ( $p < 0,01$ ) decrease in moderate asthenic syndrome cases (from 33.3% to 41.7%) and an increase in weak asthenic syndrome cases (from 16.6% to 33.4%), these changes unverified as compared to Test groups 1 and 2. Note-worthily, a significant ( $p < 0,01$ ) decrease in moderate asthenia cases and increased number of mild asthenia cases after neuroprotection (Test group 1) in comparison with the results of patients after a comprehensive rehabilitation program (Test group 2).

All patients were evaluated as to the duration of the sick leave. 16 patients (80%) in the Test group 1 and 16 patients (72%) in the Test group 2 resumed works immediately after the termination of the neuroprotection or the rehabilitation program in comparison with 5 patients (41.6%) in the Control group. On average, the duration of sick leave with patients of the Test group 1 was  $5.3 \pm 1.4$  days shorter than those in Test group 2 and  $6.4 \pm 2.2$  shorter than those of the Control group – all data were verified ( $p < 0,01$ ).

## DISCUSSION

In this research, 100% patients gave complaints characteristic of asthenic syndrome as a manifestation of PCNS and significantly impaired the patient's productivity as well their quality of life. Also, all patients showed different types of asthenic syndrome with prevalence of severe and moderate degrees. All patients who underwent neuroprotection therapy showed an improvement in well-being, activity and mood up to a higher level. After both the neuroprotection and rehabilitation programs, the following redistribution of asthenic syndrome cases was observed: in both Test groups no extreme asthenic syndrome cases were identified, with some asthenic syndrome cases eliminated altogether. It should be noted that in Test group 1, the patients who received neuroprotection showed a significant improvement in the performance of

the WAM test i.e. well-being, activity and mood; reduced the incidences of general and physical asthenia, increased activity and motivation (according to MFI-20); reduction in the severity of the manifestations of asthenic syndrome (according to ASS), compared with the Test group 2, who performed only a comprehensive rehabilitation program.

The neuroprotection programme offered envisages has several routs of influence. Citicoline protects cell membranes through the resynthesis of phospholipids. Cerebrolysin supports endogenous repair and recovery processes in the brain. Among the relevant molecular processes targeted by Cerebrolysin are excitotoxicity, overproduction of reactive oxygen species, uncontrolled apoptosis, and inflammatory processes. A neuroprotective effect of Vinpocetine is contributes to the inhibition of the operation of voltage-dependent neuronal Na (+)-channels, indirect inhibition of some molecular cascades initiated by the rise of intracellular Ca (++)-levels and inhibition of adenosine reuptake. In addition, Vinpocetine improves cerebral perfusion globally by reducing the vascular tone of cerebral vessels and normalizing the rheologic properties of the blood, increases tolerance of cerebral tissue to hypoxia. Several authors have shown that Nootropil treatment offers protection against oxidative stress, inflammatory responses and may be used in brain/neuro-degenerative diseases [20]. Determining a more specific mechanism of action of neuroprotection on PCNS requires further study in order to select the most rational combination of neuroprotective drugs. The original representative results obtained in the present study indicate the efficacy of the low cost comprehensive rehabilitation program for the speedy convalescence of PCNS patients with the use of techniques of neuro-psychological examination in view to the further neuroprotection with answers the aims of research.

## CONCLUSIONS

The present research proved that of all post-COVID-19 patients, who showed signs of asthenic syndrome from predominantly moderate to extreme severity, the patients who followed neuroprotection programme significantly reduced

verifiable severity of PCNS as well as the disability duration. It was also shown that administration the comprehensive rehabilitation program alone tends to have an overall lesser effect than neuroprotection. An early neuroprotection couple with comprehensive rehabilitation intervention after the termination of the acute phase in COVID-19 effectively decreases the manifestation of PCNS in the form of asthenic syndrome and reduces the convalescence time and enhances productivity in post-COVID-19 patients.

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# Possibilities of Non-Invasive Analyzer of Blood Formula in Rehabilitation of Patients with Post-Covid Syndrome

## Możliwości nieinwazyjnej analizy składu krwi u pacjentów z zespołem pocovidowym poddawanych rehabilitacji

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### SUMMARY

**Aim:** Formation of goals of the rehabilitation process of patients with the post-covid syndrome in accordance with the needs of the patient, and the results of sufficient diagnosis.

**Materials and Methods:** A total of 132 people were examined. In 48 patients diagnosed with COVID-19 coronavirus (PCR test). Diagnosis of study participants occurred after 8-12 weeks of the acute period. None of the patients after the acute period of the disease underwent a course of rehabilitation treatment. The diagnosis was performed using a non-invasive blood formula analyzer AMP. Before the measurement, the respiratory rate, heart rate, and the patient's weight, age, and sex were recorded. Statistical data processing was performed using the statistical package MedStat.

**Results:** The values of such indicators as the Tiffno test, dopamine- $\beta$ -hydrolase, skeletal muscle circulation, the complex factor regulating cell mitosis were out of the norm in the group of participants who suffered from covid-19, but compared with the control group, was not found a statistically significant difference between the above indicators ( $p > 0.05$ ). Such values are a consequence of the disease and are the basis for describing the main long-term consequences that correspond to the post-covid syndrome.

**Conclusions:** The goals of the rehabilitation process of patients with the post-covid syndrome should be formed in accordance with the positions of evidence-based medicine. The non-invasive blood formula analyzer allows determining the direction of rehabilitation treatment taking into account concomitant chronic diseases and taking into account the patient's ability to carry out the correction of rehabilitation programs in real-time.

**Key words:** the post-covid syndrome, physical therapy, rehabilitation program, non-invasive diagnostic

**Słowa kluczowe:** zespół pocovidowy, fizjoterapia, program rehabilitacji, diagnostyka nieinwazyjna

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### INTRODUCTION

The prolonged pandemic caused by coronavirus disease COVID-19 continues to create new challenges for the health care system. The complexity lies in a large number of confirmed cases of the disease, and in the severe course of the disease in some groups of patients, as well as in the long-term consequences after the disease [1, 2]. The process of patient recovery also remains relevant. But despite the complexity of the disease, complications after an acute period occur in most cases. Increasing attention of physical therapists is drawn to long-term symptoms of COVID-19, which are

concentrated in the period from 4 to 12 weeks after the acute period, or post-covid symptoms lasting more than 12 weeks. The problem of recovery of such patients is explained by the lack of quality examination, which should be the basis for the development of any rehabilitation program.

### AIM

Formation of goals of the rehabilitation process of patients with the post-covid syndrome in accordance with the needs of the patient, and the results of sufficient diagnosis, which is provided by a non-invasive AMP analyzer.

## MATERIALS AND METHODS

The research was conducted at the Research Center for Innovative and Non-Invasive Technologies of the National University "Ostroh Academy". The research has done according with recommendation of the Research ethics committee. A total of 132 people aged 26 to 80 were examined. In 48 patients diagnosed with COVID-19 coronavirus (PCR test) had different forms of the course: from mild to disease with complications, in some cases the disease was asymptomatic. Diagnosis of study participants occurred after 8-12 weeks of the acute period. In terms of well-being, all subjects most often noted fatigue, weakness, anxiety, and depression. None of the patients after the acute period of the disease underwent a course of rehabilitation treatment.

The diagnosis was performed using a non-invasive blood formula analyzer AMP [3, 4]. The analyzer allows a comprehensive assessment of the organism from the standpoint of its functional-metabolic and hemodynamic balance, hydrogen metabolism, and gas homeostasis. Accordingly, data of a blood formula, biochemical indicators of blood, the indicators characterizing a metabolism, indicators of neuromuscular conductivity on the basis of the content of K, Na, Ca, Mg in blood were received. The following indicators were analyzed: myocardial blood supply, functional hemodynamics, water-electrolyte balance, the state of the cardiorespiratory system, and the body's compensatory capabilities. The following indicators were used to assess the respiratory system: Tiffno test, gas exchange surface, lung vital capacity, pulmonary ventilation, maximum airflow, CO<sub>2</sub> release, respiratory rate, arterial blood saturation O<sub>2</sub>, oxygen transport, oxygenation rate, O<sub>2</sub> consumption, tissue index volume of circulating blood, minute volume of blood circulation.

To assess the cardiovascular system, the analysis of indicators was performed: intervals PQ, QT, QRS, heart rate, myocardial circulation, left ventricular contraction, systolic volume, myocardial O<sub>2</sub> consumption, the resistance of the small circulation, central venous pressure, CO<sub>2</sub> content in CO<sub>2</sub> and arterial blood. Analysis was performed by indicators: glucose concentration, glycogen, total cholesterol, low, high, and very low-density lipoproteins, triglycerides, plasma velocity, dopamine- $\beta$ -hydrolase. The condition of the central nervous system was assessed by indicators: the width of the third ventricle of the brain, cerebral circulation, and consumption of O<sub>2</sub> per 100 g of brain tissue, acetylcholine, acetylcholinesterase erythrocytes, and cerebrospinal fluid pressure. The musculoskeletal system was estimated on a blood groove of skeletal muscles, the concentration of lactic acid, time of one-time loading, creatinine kinase of muscles. In addition, indicators such as the index of vascular permeability, a complex factor in the regulation of cell mitosis, the cost of life support, the working level of oxygen consumption, the rate of CO<sub>2</sub> production were taken into account.

The study was conducted in accordance with the requirements of the authors [5]. In a well-lit ventilated room at an air temperature of 20-24°C. Before the measurement, the respiratory rate, heart rate, and the patient's weight, age,

and sex were recorded. To obtain data used five temperature sensors, which were placed in areas of large vessels (neck, abdomen, groin). The recording lasted from two to three minutes.

Statistical data processing was performed using the statistical package MedStat [3]. Depending on the distribution of data that were different from the normal distribution of values, we used descriptive statistics (median, median error, quartiles I and III), Wilcoxon test, Kruskal-Wallis test. For reliability, the obtained data were compared with the control group.

## RESULTS

Statistical analysis of the indicators obtained as a result of diagnosis of study participants showed that their distribution differs from normal. Accordingly, non-parametric criteria were used in the further analysis. Descriptive statistics included the calculation of the median and quartiles (Me(25%; 75%)). Table 1 shows the indicators whose values were outside the norm.

Both in the experimental group and in the control group were overestimated: pulmonary ventilation, heart rate, and CO<sub>2</sub> content in venous blood, plasma density, the width of the third ventricle of the brain, the cost of life support, and the working level of oxygen consumption. Below the norm in both groups were the values of gas exchange surface and O<sub>2</sub> consumption per 100 g of brain tissue. It can be connected with a low level of physical activity, lack of training, disturbance of regulation of water metabolism in an organism (disturbance of daily norm of liquid).

Although the values of such indicators as the Tiffno test, dopamine- $\beta$ -hydrolase, skeletal muscle circulation, the complex factor regulating cell mitosis were out of the norm in the group of study participants who suffered from coronavirus disease, compared with the control group, was not found a statistically significant difference between the above indicators ( $p > 0.05$ ). In our opinion, such values are a consequence of the disease and are the basis for describing the main long-term consequences that correspond to the post-covid syndrome.

The rank one-factor analysis of Kruskal-Wallis between the indicators revealed a difference in the level of significance  $p < 0,001$ .

When comparing the centers of independent samples in the experimental group, statistical differences were found between the values of the Tiffno test, dopamine- $\beta$ -hydrolase, the cost of life support, the complex factor

## DISCUSSION

It is known, that the rehabilitation treatment required by patients after an acute period of coronavirus disease should be individualized according to the needs of the patient, taking into account comorbidities. An important problem in planning an individualized rehabilitation program for patients with post-covid conditions is the emergence of long-term symptoms that are not explained by an alternative diagnosis [6]. The quality of an individual rehabilitation program, above all, depends on the diagnosis, which is carried out both before the creation of the program and during its use for correction,

**Table 1.** The indicators whose values were outside the norm compared with the control group

|   | The group of patients after COVID-19, n=48 | Control group n=84              | Normal values |
|---|--|---------------------------------|---------------|
| Age   | 49 (39; 54)                                | 47 (36; 56)                     |               |
| Tiffno test, %  | 78,535<br>(73,17; 89,575)                  | 81,76<br>(72,105; 91,905)       | 109-80        |
| Gas exchange surface, m <sup>2</sup>                            | 3373,46<br>(3246,01; 3533,815)             | 3420,135<br>(3236,51; 3563,27)  | 4300-3500     |
| Pulmonary ventilation, l/min                                    | 12,23 (7,825; 14,52)                       | 12,185 (7,855; 15,06)           | 12-4          |
| Heart work, joule   | 0,825 (0,785; 0,885)                       | 0,83 (0,77; 0,88)               | 0,788-0,692   |
| The content of CO <sub>2</sub> in venous blood, %               | 62,535<br>(61,525; 63,345)                 | 62,505 (61,195; 63,595)         | 53-51         |
| The plasma density, g/l   | 1046,705<br>(1044,145; 1050,655)           | 1048,775<br>(1044,25; 1051,285) | 1055-1048     |
| Dopamine -β-hydrolase mmol/l                                    | 26,65<br>(23,445; 27,975)                  | 28 (24,175; 28,36)              | 32,5-28       |
| The width of the third ventricle of the brain, mm               | 6,785 (6,235; 7,305)                       | 6,84 (6,205; 7,405)             | 6-4           |
| The consumption of O <sub>2</sub> per 100 g of brain tissue, ml | 2,425 (2,215; 2,71)                        | 2,59 (2,32; 2,885)              | 3,4-2,8       |
| The skeletal muscle blood flow, ml/l                            | 917,69<br>(847,965; 1036,705)              | 949,535<br>(847,475; 1036,99)   | 1081,4-930    |
| The complex factor regulating cell mitosis                      | 4,20425<br>(3,5436; 4,44315)               | 4,1342<br>(3,64995; 4,35225)    | 4,1372-3,7828 |
| The consumable capacity of life support, kkal/kg/min            | 6,96 (5,53; 9,17)                          | 6,31 (4,6; 8,595)               | 4,3-1,23      |
| The working level of oxygen consumption, %                      | 68,055<br>(65,095; 70,09)                  | 68,1<br>(65,1; 70,825)          | 60-45         |

as well as at the end of the course of therapeutic interventions to assess effectiveness.

When analyzing the data, according to patient complaints and the results obtained, we concluded that the rehabilitation program for post-covid patients can have several directions. Monitoring has shown that there are several indicators that indicate disorders that may be characteristic of post-covid syndrome and that need further study.

Quite a significant indicator is the Tiffno test, which characterizes the elasticity of the cardiorespiratory system. The lower the Tiffno index, the higher the resistance of the small circle of blood circulation, as a rule, a decrease in the Tiffno index is accompanied by an increase in the minute blood circulation of the lungs and a decrease in their alveolar surface. The so-called symptom of shortness of breath (shortness of breath), which occurs in people during the acute phase of coronavirus disease and lasts more than 12 weeks, occurs as a result of a decrease in the respiratory surface of the lungs.

On average, the energy spent on livelihood is 2300 kcal for a person weighing 70 kg per day. The expendable power of life support is closely connected with the saturation of arterial blood with oxygen and with the ability of hemoglobin to connect and give oxygen to fabrics. Decrease of this indicator informs about a decrease in absorption of oxygen by fabrics and bodies, first of all by a myocardium, liver, smooth muscles, kidneys, a diaphragm.

Reduction of blood supply of skeletal muscles is explained by a sedentary way of life deprived of training as at daily motor activity the person cannot involve in work all skeletal muscles. Patients who have suffered from coronavirus disease, especially with the severe course, often experience fatigue and weakness during physical activity. Doctors often diagnose sarcopenia in patients after COVID-19, which is becoming more common in post-covid conditions. Failure to perform certain physical work in most cases is not an incentive for people to start rehabilitation, on the contrary, it often leads to the development and complication of psychological and neurocognitive symptoms.

Decreased levels of dopamine-β-hydrolase are accompanied by the development of various types of asthenic-neurotic and asthenic-depressive states, which explains the feeling of anxiety, stress, and depression in patients after coronavirus disease.

Such an indicator as a complex factor in the regulation of cell mitosis also requires constant monitoring. In our opinion, its values above the norm indicate the processes of regeneration in damaged tissues and systems. Although in the course of a comprehensive diagnosis, with normalized indicators that are responsible for the condition of organs and systems, this indicator may indicate the likelihood of developing cancer.

The planning of the rehabilitation process should take place only after the diagnosis, with the exception of unstable

conditions, so that patients can safely begin the rehabilitation process. The above symptoms and the indicators that confirm them indicate the value of a multidisciplinary approach in rehabilitation treatment. After all, the rehabilitation process should include retraining of breath, psychological support, correction of physical activity. At all levels of rehabilitation, the physical therapist of a multidisciplinary team should focus on the development of endurance, strength, balance. An important element of the program is also a lesson aimed at developing the strength of the respiratory muscles and the correction of the frequency, rhythm, and depth of breathing.

In the context of post-covid syndrome, a set of measures aimed at optimizing functioning, health and well-being may include physical therapy, patient education, psychological relaxation training, symptom management strategy, telerehabilitation, and patient support.

In our study, the basis for creating a program of rehabilitation treatment is diagnostic information obtained by non-invasive intervention. In this case, a non-invasive blood formula analyzer helps to see the full clinical picture of the disease, determine the direction of the rehabilitation process and the composition of the multidisciplinary team (according to the analysis, the team may involve a nutritionist, psychotherapist, family doctor). The obtained diagnostic information ensures the safety of the rehabilitation program, as concomitant diseases are not ignored. This is an adequate approach to continuous monitoring of the patient's condition during the rehabilitation period, which allows if possible adjusting the program without harm to the patient. To create a quality program, the data obtained from the AMP must be supplemented by general and special tests.

## CONCLUSIONS

The goals of the rehabilitation process of patients with the post-covid syndrome should be formed in accordance with the positions of evidence-based medicine. The non-invasive blood formula analyzer allows determining the direction of rehabilitation treatment taking into account concomitant chronic diseases and taking into account the patient's ability to carry out the correction of rehabilitation programs in real-time.

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# Efficacy of Application of Hydrogen Sulfide Baths in Patients with Diabetic Polyneuropathy

## Skuteczność kąpieli siarkowodorowych u pacjentów z polineuropatią cukrzycową

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### SUMMARY

**Aim:** Evaluation of the effect of hydrogen sulfide baths on pain, tactile, temperature and vibration sensitivity in patients with diabetic polyneuropathy.

**Materials and Methods:** 125 patients with type 2 diabetes complicated by diabetic polyneuropathy were examined. Patients were divided into 2 groups: the 1st group included 61 patients who received standard treatment in an outpatient setting, 64 patients of the 2nd group in addition to standard treatment received hydrogen sulfide baths in a sanatorium. Sensitivity assessment was performed using a tuning fork, monofilament, atraumatic needle, Tip-Term cylinder.

**Results:** In most patients, after the initial examination, a significant decrease mainly in vibration and tactile sensitivity was observed. Only pain sensitivity was truly restored in patients receiving standard outpatient therapy. The best clinical effect of treatment (reliable recovery of all types of sensitivity) was achieved in patients who were in a sanatorium and in addition to standard therapy received hydrogen sulfide baths.

**Conclusions:** The use of hydrogen sulfide baths in the complex treatment of diabetic polyneuropathy contributes to a more effective restoration of sensitivity disorders in patients with diabetes

**Key words:** sensitivity, diabetic polyneuropathy, Hydrogen sulfide

**Słowa kluczowe:** wrażliwość, polineuropatia cukrzycowa, siarkowodór

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### INTRODUCTION

Diabetic polyneuropathy (DPN) is one of the most common complications of diabetes mellitus (DM) [1-3]. It is characterized by progressive death of nerve fibers and leads to disorders of vibration, tactile, pain and temperature sensitivity, in particular its distal form [4, 5]. That is why timely diagnosis and correct treatment of DPN is of great importance in patients with diabetes.

To date, of particular interest is the spa treatment, the tasks of which are to prevent the progression of the process, stimulate compensatory capabilities and the possible restoration of lost functions.

The main advantage of medical rehabilitation in sanatorium conditions is the possibility of comprehensive rehabilitation measures, using natural and preformed physical factors, quality control of rehabilitation according to laboratory, clinical, functional and other studies.

Over the years of using hydrogen sulfide balneotherapy in the sanatorium treatment of patients with various diseases, a

scientific justification of the methodology of its implementation is given. Its periodicity, multiplicity, duration, seasonality, compatibility, as well as the concentration of hydrogen sulfide in mineral water has also been determined [6]. However, despite its long-term use in clinical practice, it is promising to study the effect of sulfide balneotherapy procedures on sensitivity in patients with diabetic polyneuropathy.

The experience of hydrogen sulfide-aided treatment of DPN patients in resorts shows its high efficiency [6, 7]. The mechanism of therapeutic action of hydrogen sulfide is mediated through the activation of protective and adaptive forces (primarily the state of the immune and pituitary-adrenal systems) and results in strengthening local blood and lymph circulation, improving metabolic and trophic processes, activation of regenerative functions, regulation and restoration of impaired functions of various body systems [6].

A characteristic feature of the action of hydrogen sulfide baths on the body is the emergence of parallel and, especially,

sequential (chain) reactions, involving both hydrogen sulfide and the products of its transformations – sulfate and sulfhydryl groups [8].

### AIM

The aim is to evaluate the effect of hydrogen sulfide baths on pain, tactile, temperature and vibration sensitivity in patients with diabetic polyneuropathy.

### MATERIALS AND METHODS

125 patients with type 2 diabetes and diabetic polyneuropathy were examined. The age of the subjects ranged from 45 to 65 years (mean age  $56.46 \pm 5.79$  years). The duration of diabetes and DPN ranged from 5 to 21 years (average duration  $9.82 \pm 3.85$  years) and 1-13 years (average duration  $5.55 \pm 2.94$  years) respectively. All patients under examination were divided into 2 groups depending on the received treatment program: the control group (1<sup>st</sup> group) included 61 patients who received standard treatment in outpatient departments according to the unified clinical protocol of primary and secondary (specialized) medical care (№1118 from 21.12.2012) in outpatient departments [9]. 64 patients of the 2<sup>nd</sup> experimental group were on sanatorium treatment and in addition to standard drug treatment received №8 hydrogen sulfide baths for 14 days.

Mineral hydrogen sulfide-calcium low-mineralized neutral water of the following composition was used for traditional hydrogen sulfide balneotherapy:

***HCO356–62 SO425–37 CL–18–19***

***Ca71–78Mg19–24Na11–17***

*H<sub>2</sub>S* 0,017–0,065 *M* 0,76–0,8 pH = 6,8–7,2

Water heated to 37–38°C was fed by a water pipe from a well directly into a bath with a hydrogen sulfide concentration of 55–75 mg/l. The patient's stay in the bath is 10-15 minutes. Baths were taken every other day totaling in a course of 8 procedures.

The groups were comparable in age, duration of diabetes and the severity of clinical manifestations of DPN (Table 1).

Superficial (tactile, pain, temperature) and deep (vibrational) types of sensitivity were evaluated.

Tactile sensitivity was assessed using a 5.07 caliber monofilament (which bends under a force of 10 g) on symmetrical areas of the foot (dorsal surface, plantar surface of the metatarsophalangeal joints, apical surfaces of the toes and heel). Tactile sensitivity

impairment was registered when the patient did not feel the touch of the monofilament in at least one point of the foot (free from hyperkeratosis and calluses) [10].

Pain sensitivity studies were performed by giving light injections with a blunt (atraumatic) needle.

Temperature sensitivity impairment was measured by alternating contact with symmetrical areas of the foot using a Tip-Term cylinder, the ends of which have different temperatures. Temperature sensitivity was considered lost when the patient was unable to distinguish between these stimuli.

A 128 Hz tuning fork was used to assess vibration sensitivity. To do this, the leg of the tuning fork was placed on symmetrical areas of skin in the projection of the bone protrusions and the time of the vibration sensation was measured. A decrease in the duration of perception of the vibration of the tuning fork (15-20 seconds being the norm) and the difference in perception in symmetrical points were considered to be an objective sign of vibration sensitivity impairment [11].

Analysis and processing of clinical trial statistics were performed on a personal computer using STATISTICA 10 and MS Excel XP application packages. Comparison in the group of relative values and those expressed in percentage was carried out using the Pearson test  $\chi^2$  (xi-square). The difference was considered veritable at  $p < 0.05$ .

The research methods used in the test groups of patients with DPN-complicated type 2 diabetes mellitus comply with the requirements of the World Health Association Helsinki Declaration on Ethical Principles for Scientific Research with Human Participation (1964-2000), as was confirmed on the meeting of Bioethics Commission of I.Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine of November 11, 2021.

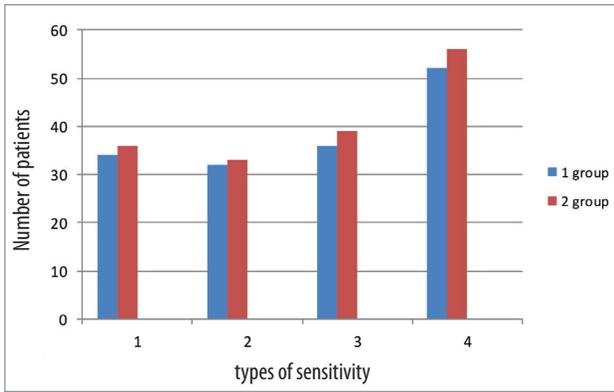
### RESULTS

Objective examination showed a decrease in vibration, temperature, tactile and pain sensitivity in 108 (86.4%), 70 (56%), 75 (60%), 65 (52%) patients respectively.

Prior to treatment, a decrease in temperature sensitivity was observed in 34 (55.74%) patients of the 1<sup>st</sup> group and 36 (56.25%) patients of the 2<sup>nd</sup> group; whereas a decrease in pain sensitivity occurred in 32 (52.45%) patients and 33 (54.09%) patients of the examined groups. Tactile and vibration sensitivity were reduced in 36 (59.02%) and 52 (85.25%) patients of the 1<sup>st</sup> group and in 39 (68.5%) and 56 (87.5%) patients of the 2<sup>nd</sup> group. There were no significant differences between groups before treatment ( $p < 0.05$ ) (Figure 1).

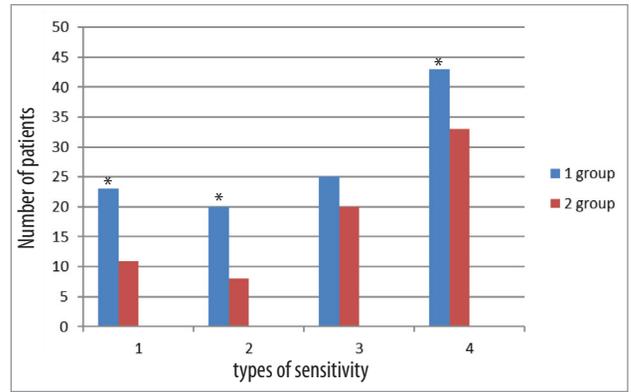
**Table 1.** General characteristics of patients with type 2 diabetes mellitus ( $M \pm \sigma$ )

| Characteristic         | 1 <sup>st</sup> group<br>n = 61 | 2 <sup>nd</sup> group<br>n = 64 | F    | P      |
|------------------------|---------------------------------|---------------------------------|------|--------|
| Age, years             | 58.66±5.20                      | 55.53±6.5                       | 2.15 | p>0.05 |
| Duration of DM, years  | 8.56± 3.25                      | 10.13±3.4                       | 1.72 | p>0.05 |
| Duration of DPN, years | 4.91± 2.82                      | 5.19± 2.91                      | 1.27 | p>0.05 |



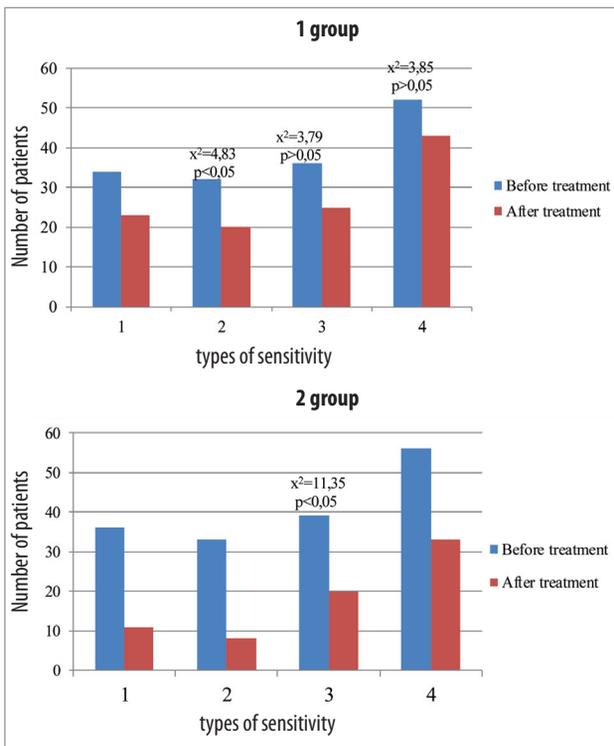
**Figure 1.** The results of the patients' sensitivity diagnosis in the study groups before treatment.

Notes: 1 – temperature sensitivity; 2 – pain sensitivity; 3 – tactile sensitivity; 4 – vibration sensitivity. \* – the difference between the groups before treatment is significant ( $p < 0.05$ )



**Figure 3.** Dynamics of sensitivity recovery between groups of patients under the influence of applied treatment programs

Notes: 1 – temperature sensitivity; 2 – pain sensitivity; 3 – tactile sensitivity; 4 – vibration sensitivity. \* – the difference between the groups before treatment is significant ( $p < 0.05$ )



**Figure 2.** Dynamics of sensitivity recovery in the examined groups of patients under the influence of the applied treatment programs

Notes: 1 – temperature sensitivity; 2 – pain sensitivity; 3 – tactile sensitivity; 4 – vibration sensitivity

In 14 days after treatment, temperature, pain, tactile and vibration sensitivity was restored in 85 (68%), 92 (73.6%), 83 (66.4%) and 46 (36.8%) patients respectively.

Comparison of sensitivity after treatment revealed a decrease in temperature sensitivity in 23 (37.70%) xi-square = 3.98  $p > 0.05$  patients of the 1<sup>st</sup> group, 11 (17.19%) xi-square = 20.01  $p < 0.05$  of the 2<sup>nd</sup> group. Pain sensitivity in 20 (32.79%) xi-square = 4.83  $p < 0.05$  patients of the 1<sup>st</sup>, 8 (12.5%) xi-square = 22.43  $p < 0.05$  patients of the 2<sup>nd</sup> group. Tactile and vibration sensitivity were reduced in 25 (40.98%) xi-square = 3.79  $p > 0.05$  and 43 (70.49%) xi-square = 3.85

$p > 0.05$  patients of the 1<sup>st</sup> group and 20 (31.25%) xi-square = 11.35  $p < 0.05$  and 33 (51.56%) xi-square = 19.508  $p > 0.05$  patients of the 2<sup>nd</sup> group respectively (Figure 2).

The results of the comparison of sensitivity between groups after treatment are shown in Figure 3.

## DISCUSSION

The study conducted before treatment revealed a significant decrease in mostly vibrational and tactile sensitivity in all examined patients, which corresponds to the literature data [12-14].

These treatments had a good clinical effect, namely the improvement of sensitivity, which we observed in all groups of examined patients. However, only pain sensitivity was reliably restored in group 1 patients who received treatment only according to the diabetic polyneuropathy treatment protocol. The best clinical effect of treatment (reliable recovery of all types of sensitivity) was achieved in patients of group 2, who in addition to the protocol treatment received hydrogen sulfide balneotherapy.

## CONCLUSIONS

The use of hydrogen sulfide baths at the spa stage of rehabilitation in patients with diabetic polyneuropathy contributes to a more effective restoration of sensitivity disorders in patients with diabetes, which allows us to recommend annual sanatorium treatment with hydrogen sulfide balneotherapy.

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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 revision of the article, F – Final approval of article

Info

### **ABOUT THE JOURNAL ACTA BALNEOLOGICA**

Acta Balneologica is the scientific journal of the Polish Association of Balneology and Physical Medicine. It was created in 1905. The articles published in the bimonthly journal include peer-reviewed original papers, review papers, and case studies concerning spa medicine (balneology, bioclimatology, balneochemistry, hydrogeology) and physical medicine (physiotherapy, cryotherapy, kinesiotherapy, pressotherapy, and rehabilitation). The journal is unique for its subject matter not only in Poland, but also in Europe.

Every year, Acta Balneologica provides media patronage for many scientific medical events.

The journal is addressed not only to doctors and rehabilitation and physiotherapy specialists who use knowledge from the field of balneology and physical medicine in their work, but also to heads of hospital departments, hospital directors, thermal stations and sanatorium managers, managers of public and private hospitals, clinics, and SPA and wellness centres, and specialists in other fields of medicine.

The Journal has been included in the register of journals published by The Polish Ministry of Education and Science with 20 points awarded.

The journal is indexed by the Index Copernicus, Web of Science (ESCI), Ministry of Education and Science and the Polish Medical Bibliography.

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# Improving the Quality of Medical Care and Prevention in Patients with Type 2 Diabetes on the Basis of Remote Medical Service

## Poprawa jakości opieki medycznej i prewencji u pacjentów z cukrzycą typu 2 w sytuacji porad medycznych świadczonych na odległość

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### SUMMARY

**Aim:** To analyze the effectiveness of implementation of remote medical service, involving patients with type 2 diabetes mellitus in dynamic monitoring of their health and treatment, designed to optimize the quality of medical care and prevention at the primary health care level.

**Materials and Methods:** The study included adults aged 18 to 70 years, residents of Sumy who suffer from diabetes. They took part in a medical and sociological survey before introduction of the ICS and gave consent for processing and using of their personal data. A total of 96 patients were involved. We conducted a survey form of the study, using a closed questionnaire for medical and sociological research, conducted during December 2019. The study included such methods as systematic approach, bibliosemantic, comparative and statistical analyses, logical generalization.

**Results:** During the following medical and sociological survey, 96 questionnaires from Sumy residents aged 18 to 69 years, 58 women (60,42±3,53%) and 38 men (39,58±3,53%) were studied. Analysis of re-monitoring results showed that during the period of implementation of the ICS at the level of primary health care, the indicators of MCQ and health status of respondents have improved. The proportion of patients, who regularly control the level of blood pressure, increased by 32.29%, and those, who control the level of blood glucose – by 31.24%. The incidence of hypoglycemia and/or ketoacidosis states has decreased by 4.17%. During the survey, the part of respondents with targeted blood pressure level increased by 25.00% and the number of respondents with satisfactory level of diabetes compensation increased by 29.18%. The survey showed that more respondents (12.5%) began to regularly take prescribed medications; the number of those, who began to follow diet and dietary regimen has increased by 28.12%; 5.19% of respondents abandoned bad habits (smoking). The number of respondents who have a body mass index  $\geq 30.0$  has decreased by 4.69%.

**Conclusions:** The introduction of information and communication system (ICS) with feedback between patient and provider of medical services at the primary health care institution level has shown a positive impact on involvement of patients in dynamic monitoring of their health, responsible attitude to prevention of chronic non-communicable diseases` development and their complications, awareness of the impact of modified risk factors on their health.

**Key words:** prophylaxis, healthcare quality, diabetes mellitus, information-communicative systems, behavioral economics

**Słowa kluczowe:** profilaktyka, jakość opieki zdrowotnej, cukrzyca, systemy informacyjno-komunikacyjne, ekonomia behawioralna

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### INTRODUCTION

Type 2 diabetes mellitus (DM) and its prevention is a global health system problem, which annually keeps being increasingly relevant. According to the World Health Organization (WHO), there are about 425 million patients with DM in the world. Over the past 50 years, the prevalence of DM has increased 10 times and continues to grow at an alarming rate. Despite the presence of effective drugs, modern technologies, new educational and preventive methods, the level of disability

and disability loss increase due to complications; at the same time the duration and quality of life of patients decrease. Every year 3 million deaths, caused by DM, are registered in the world, that is, every 10 seconds 1 diabetic patient dies [1, 2].

Unlike DM 1, type 2 diabetes is mainly a consequence of the modern lifestyle and nutrition in population. Sedentary lifestyle, fast food, bad habits combined with excess body weight increase the risk of developing DM 2 type [3]. In

accordance with international recommendations and guidelines for prevention of type 2 DM (International Diabetic Federation – IDF; American Diabetic Association – ADA) all patients who have a high risk of type 2 DM (IFG (impaired fasting glycaemia), IGT (impaired glucose tolerance)), are required to carry out primary prevention measures: diet, controlled physical activity, lifestyle correction, taking metformin [4, 5]. The recommendations are based on the results of several large-scale randomized clinical studies, which demonstrated that lifestyle change/behavioral therapy and using a metformin are the most effective methods of primary and secondary prevention of diabetes and its complications [6].

Effective application of mechanisms of “behavioral economics” and psychological well-being are fundamental to achieve the goals in treating people with diabetes. Patients’ training and support with diabetes self-control, diet and dietary regimen, routine physical activity, advising on quitting smoking when necessary, and psychosocial care are important to achieve these goals [7, 8].

Optimizing the medical care quality (MCQ) for people with diabetes is in creating and maintaining conditions that encourage them to make right decisions for prevention of modified risk factors, self-service/self-control and, just as important, active cooperation with healthcare team to improve clinical outcomes, health and well-being in a cost-effective way. After initial comprehensive medical assessment, patients and providers of medical services are recommended to participate in prevention of diabetes and its complications; that is, medical care should be personality-oriented and guided by joint decision-making in choosing a treatment regimen, facilitating the access to necessary medical and psychosocial resources and joint monitoring of agreed regime and lifestyle [9-12]. Reexamination during routine care should include not only assessing the state of health, but also behavioral and mental outcomes, especially during the deterioration of health [13].

The main tasks of health care systems in the organization of medical care in people with diabetes, both worldwide and in Ukraine, are to increase life expectancy, improve its quality, which is estimated by proper compensation of disease. One of the WHO’s strategic plans to solve these problems is development of information and communication technology (systems) (ICS) for prevention and continuous monitoring of health indicators in people with chronic non-infectious diseases, including diabetes. The development of new technologies is extremely fast. Every year new approaches and tools become available; by the time one study is completed, new versions of devices already appear on the market. The most important participant in all these systems is a patient, that is, the choice of technology should correspond the individual. This emphasizes the need to optimize medical services for patient in choosing a device/program and maintaining its use through constant training. However, it should be noted that yet we do not have a technology that would minimize the issue of active involving patients with diabetes to continuous monitoring of their health; create conditions and stimuli to ensure a responsible attitude to the treatment regimen, prevent complications, form

a healthy lifestyle [14-16]. Creation of the information space of health care in Ukraine with ICS involvement to preserve and strengthen health in population, ensure rights of citizens for health care is task of the top-priority. The introduction of a modern industrial model of continuous improvement of MCQ in a healthcare institution with development and implementation of automated ICS remains relevant [17, 18]. A significant point of improvement will be in introduction of ICS, which makes it possible to improve patient’s responsibility for own health, optimizes the work of a doctor and, in our opinion, contributes to involvement of patients’ state in the process of dynamic monitoring by holding responsibility for their health.

## AIM

To analyze the effectiveness of remote medical service implementation, involving patients with type 2 diabetes mellitus for dynamic monitoring of their health and treatment, designed to optimize the quality of medical care and prevention at the primary health care level.

## MATERIALS AND METHODS

The study was conducted among adults aged 18 to 70 years, residents of Sumy, suffering from diabetes. They took part in a medical and sociological survey before introduction of the ICS and gave consent for processing and using their personal data. A total of 96 patients were involved. Then, during six months of 2019, an algorithm of dynamic bilateral observation and treatment using the ICS “Remote medical service in the medical care quality management system at the primary level” was implemented. The form of the study is a survey, using a closed questionnaire for medical and sociological research, conducted during December 2019. The questionnaires were certified and approved by the Academic Council of the Medical Institute, Sumy State University. During the study we used a systematic approach, bibliosemantic, comparative and statistical analyses, logical generalization. With the functions of Google Forms and Microsoft Excel 2010, Windows, the following processing and statistical analysis of the obtained data were carried out: descriptive statistics, calculation of the error of relative value (m).

The study was approved by the ethics committee of the Sumy State University, in accordance with the requirements of the Tokyo Declaration of the World Medical Association and the International Recommendations of the Helsinki Declaration of Human Rights.

## RESULTS

The medical and sociological survey concerned the identification of patients’ awareness of the course of disease and prevention of its complications, the regularity of diagnostic and therapeutic measures, awareness of responsibility for their health and importance of their active participation in prevention of modified risk factors influence.

The evaluation of effectiveness of remote medical service implementation at the level of the primary health care was carried out according to the results of indicators’ analysis, approved with the unified clinical protocol of medical care for

patients with type 2 DM, who are under dynamic observation of FPs (family practitioners) [19, 20].

Thus, 96 questionnaires from Sumy residents, aged 18-69 years, women – 58 (60,42±3,53%), men – 38 (39,58±3,53%) were studied.

Patients aged 18-29 were 1,04±0,73%; aged 30-39 – 5,21±1,75%; aged 40-49 years – 9,38±2,16%, aged 50-59 – 28,13±3,23%, aged 60-69 – 56,25±3,58%. The age-sexual data of the respondents, who took part in the survey, are given further on.

In the patients who took part in the survey, the majority suffers from type 2 DM from 6 to 10 years – 34,38±6,8%; from 1 to 5 years – 31,25±6,69%; 11-15 years – 16,67±5,63%; 16-20 years – 17,71±5,39%.

Analysis of the results of re-monitoring showed that during the period of implementation of ICS at the level of primary health care, the indicators of MCQ and health status of the respondents have improved.

Thus, after ICS implementation the percentage of patients, who regularly control the level of blood pressure (BP), increased by 32.29% and amounted to 76,04±3,08%, compared to data, obtained in 2018 (43,75±3,58%). The proportion of patients who regularly control the level of glycemia increased by 31.24% and equaled 60,41±2,93%, compared to the data, obtained in 2018 - 29,17±2,69%. Also, the part of respondents with the target level of AP has increased by 24.47%. The initial survey had found that only 21,88±2,98% of respondents had the target level of AP; after the experiment this index was 46,35±3,60%. There was an increase by 21.88% in the share of respondents, who have a satisfactory level of DM compensation. In 2018, this figure was 45,83±3,60%, and in results of the resurvey – 67,71±3,37%. With the probability of

error corresponding to the value of the chi-square criterion ( $p < 0,001$ ), it can be stated that change in frequency of the investigated features is reliable (Tables 1 and 2).

Analyzing the data given in Table 3, we conclude that patients began to actively visit FPs for prophylactic purposes in 2019. The proportion of patients who visited their FPs 2 times or more during the analyzed period increased from 72,92±3,58% in 2018 to 90,63±2,88% in 2019 (+ 17.71%). The share of patients who visited the doctor once a year decreased from 14,58±5,09% to 9,38±3,06% (-5.20% difference), and the number of patients who have never visited a doctor for prophylactic purposes decreased by 8.33% (after introduction of the experiment all respondents have visited FPs at least once). The share of respondents, who indicated that they had undergone a full preventive examination during the period of the study, increased by 18.23% (from 47,92±3,61% to 66,15±3,42%). The proportion of patients who received specialist advice (endocrinologist, neurologist, ophthalmologist, cardiologist, surgeon) has increased as well.

The data obtained at the time of the survey on level of glycemia and blood pressure, showed that the share of respondents who have the target level of blood pressure increased by 25.00% (from 38,54±3,56% to 63,54±3,60%). The share of respondents, who have a satisfactory level of compensation for DM (fasted glycemia), increased by 29.18%. A survey in 2018 showed that 11,45±2,20% had a satisfactory level of DM compensation; in 2019 this index was 40,63±3,37% during the survey.

Compared to the survey before the introduction of the ICS, during which 79,17±2,93% of respondents noted the regular taking of medications prescribed, this index increased by 12.50% and was equaling 91,67±1,99%.

**Table 1.** Questioning results in respondents with type 2 DM on glycaemia control

| № | Control frequency rates              | Patients` and their health state data, % |               | Difference, % | Significance level, p |
|---|--------------------------------------|--|---------------|---------------|-----------------------|
|   |                                      | November 2018                            | December 2019 |               |                       |
| 1 | 2                                    | 3  | 4             | 5             | 6                     |
| 1 | Every day                            | 8,33±1,99                                | 20,83±2,93    | +8,33         | <0,001                |
| 2 | 2-3 times a week                     | 16,67±2,69                               | 39,58±3,53    | +22,91        | <0,001                |
| 3 | Once a week                          | 22,92±3,03                               | 29,17±3,28    | +6,25         | <0,001                |
| 4 | Once a month                         | 47,92±3,61                               | 8,85±2,05     | -39,07        | <0,001                |
| 5 | Once per 3 months                    | 2,08±1,03                                | 1,56±0,89     | -0,52         | <0,001                |
| 6 | Once per 6 months, or do not control | 2,08±1,03                                | -             | -2,08         | <0,001                |

**Table 2.** Questioning results in respondents with type 2 DM on arterial pressure control

| № | Control frequency rates | Patients` and their health state data, % |               | Difference, % | Significance level, p |
|---|-------------------------|--|---------------|---------------|-----------------------|
|   |                         | November 2018                            | December 2019 |               |                       |
| 1 | 2                       | 3  | 4             | 5             | 6                     |
| 1 | 2 times a day           | 22,92±3,03                               | 31,25±3,35    | +8,33         | <0,001                |
| 2 | Once a day              | 20,83±2,93                               | 44,79±3,59    | +23,96        | <0,001                |
| 3 | 2 times a week          | 21,88±2,93                               | 11,98±2,34    | -10,94        | <0,001                |
| 4 | Once a week             | 13,54±3,03                               | 5,73±1,68     | -15,10        | <0,001                |
| 5 | Once a month            | 15,63±2,69                               | 3,13±1,26     | -9,37         | <0,001                |

**Table 3.** Efficacy of ICS implementation, according to the data obtained from respondents with type 2 DM

| №  | Indicators   | Patients` and their health state data, % |               | Difference, % | Significance level, p |
|----|--|--|---------------|---------------|-----------------------|
|    |  | November 2018                            | December 2019 |               |                       |
| 1  | 2  | 3  | 4             | 5             | 6                     |
| 1  | Have BP cuffs  | 97,92±1,03                               | 98,96±0,73    | +1,04         | <0,001                |
| 2  | Have glucometers   | 50,0±3,61                                | 69,79±3,31    | +19,79        | 0,003                 |
| 3  | Had cases of hypoglycemia or/and ketoacidosis  | 6,25±1,75                                | 2,08±1,03     | -4,17         | <0,001                |
| 4  | Attended FP (family practitioner) 2 times a year or more (for prophylactic purposes) | 72,92±3,58                               | 90,63±2,88    | +17,71        | 0,014                 |
| 5  | Attended FP only once a year (for prophylactic purposes)                             | 14,58±5,09                               | 9,38±3,06     | -5,20         | <0,001                |
| 6  | Did not attend FP at all during recent year  | 8,33± 3,99                               | -             | -8,33         | <0,001                |
| 7  | Underwent full prophylactic examination  | 47,92±3,61                               | 66,15±3,42    | +18,23        | 0,032                 |
| 8  | Have target AP level during survey   | 38,54±3,56                               | 63,54±3,37    | +25,00        | <0,001                |
| 9  | Satisfactory level of DM improvement (fasted glycaemia) during survey                | 11,45±2,20                               | 40,63±3,37    | +29,18        | 0,034                 |
| 10 | Take medicines regularly (treatment from DM and AH)                                  | 79,17±2,93                               | 91,67±1,99    | +12,50        | <0,001                |
| 11 | Take medicines irregularly (treatment from DM and AH)                                | 20,83±2,93                               | 8,33±1,99     | -12,50        | <0,001                |

After the experiment, a resurvey showed that 28.12% more respondents began to follow the diet and dietary regimen. In 2018, only 17.71±2.69% of respondents noted keeping the doctor's recommendations on diet; in 2019 this index increased to 45.83±3.60%. During the year, 5.19% of the respondents abandoned bad habits (2018 – 15.62±2.58% of the respondents, 2019 – 10.43±2.20% of the respondents). The positive impact on the conscious attitude of patients to lifestyle and control of their health is also evidenced by the data on decreasing of the number of respondents who have a body mass index  $\geq 30.0$  (from 66.67±3.40% in 2018 to 61.98±3.50% in 2019) by 4.69%.

## DISCUSSION

The data obtained during our study indicate the positive impact of the developed and implemented ICS on the state of public health and level of prevention of non-infectious diseases (NIS), on creation of conditions for ensuring a responsible attitude of patients to following doctor's appointments and health monitoring; as well as on patients' awareness of the effects of modified risk factors on their health. It has been proved that for optimization of MCQ and prevention in patients with DM, it is advisable to introduce a dynamic monitoring algorithm, which provides active involvement, feedback from the doctor and additional information.

## CONCLUSIONS

The introduction of the information and communication system and feedback between the patient and provider of

medical services at the level of primary health care institution, involving active participation of patient, supported with additional information, has shown a positive impact on the involvement of patients in dynamic monitoring of their health, on their attitude to the prevention of the development of chronic non-infectious diseases and their complications, on awareness of the impact of modified risk factors on their health by patients.

The percentage of patients who regularly control blood pressure level increased by 32.29%, and index of those, who control the level of blood glucose – by 31.24%. The incidence of hypoglycemia and/or ketoacidotic states decreased by 4.17%.

At the time of the survey, the share of respondents with targeted blood pressure level increased by 25.00% and the share of respondents with satisfactory level of diabetes compensation increased by 29.18%.

The survey showed that 12.5% more respondents began to regularly take medications prescribed by a doctor; 28.12% more people began to follow diet and dietary regimen; 5.19% of the respondents abandoned bad habits (smoking); the number of respondents, who have a body mass index  $\geq 30.0$  decreased by 4.69%.

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**Conflict of interest**

The Authors declare no conflict of interest

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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 MEiNSzW 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.

# The Influence of the Application of Mineral Water on the Functional State of the Liver of Patients after Laparoscopic Cholecystectomy in the Long Period of Rehabilitation

## Wpływ stosowania wody mineralnej na stan funkcjonalny wątroby u pacjentów po cholecystektomii laparoskopowej w długim okresie rehabilitacji

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### SUMMARY

**Aim:** To determine the effectiveness of the influence of the use of mineral medicinal water on the functional state of the liver of patients after laparoscopic cholecystectomy in a long period of rehabilitation in the conditions of the Morshynkurort health resort complex.

**Materials and Methods:** An analysis of 100 medical records of patients after laparoscopic cholecystectomy who were undergoing rehabilitation at the Morshynkurort health resort complex in 2017 and 2018 was carried out. Medical records were selected by a randomized method using the Random Allocation Rule program. Blinded evaluators while processing medical records. The method of comparison of indicators of the functional state of the liver of patients before the beginning of rehabilitation and after its completion was carried out by the method of mathematical statistics – Student's t-test. The studied parameters: total protein (g/l), thymol test (unit), total bilirubin (mkmol/l), activity of alanine transpeptidase (ALT, (units/hour · l)), aspartate transaminase (AST, (units/hour · l)), total cholesterol (mmol/l), triglycerides (mmol/l), blood glucose (mmol/l). All patients were examined before and after treatment. There was no dropout from the study among the surveyed.

**Results:** Mathematical statistics revealed a significant ( $p < 0,05$ ) improvement in such indicators as: thymol test, alanine transpeptidase activity, total cholesterol.

**Conclusions:** Hydrotherapy for 14 days MPO well No. 3-k and groundwater source No. 4 in Morshyn diluted to mineralization 3,0-3,4 g/dm<sup>3</sup> at a long stage of rehabilitation leads to an improvement in liver function in patients after laparoscopic cholecystectomy.

**Key words:** hydrotherapy, postcholecystectomy syndrome, recovery

**Słowa kluczowe:** hydroterapia, zespół pocholecystektomii, powrót do zdrowia

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### INTRODUCTION

According to the approved medical protocol for the provision of medical care to patients with cholelithiasis (housing and communal services) by the Order of the Ministry of Health of Ukraine dated June 13, 2005 N 271 "On approval of minutes for the provision of medical care in the specialty" Gastroenterology "and according to the International Classification of Diseases (CD) 10 by the method of the" gold standard "surgical treatment of housing and communal services is laparoscopic cholecystectomy.

The medical protocol states that with routine surgical intervention, the likelihood of postoperative complications is significantly reduced. Indications for surgery are divided into absolute and relative. The absolute indications for cholecystectomy include: acute calculous cholecystitis, frequent recurrent hepatic colic, non-functioning gallbladder, choledocholithiasis, pancreatitis, suspected gallbladder cancer. Relative indications for cholecystectomy include: chronic calculous cholecystitis. The document also notes that the average duration of surgical

treatment is 4-10 days (depending on the type of surgery). The criteria for the effectiveness of surgical treatment is the absence of complications of housing and communal services. According to the medical protocol, rehabilitation after surgery should include: "an individual dietary regimen (frequent small meals with the exclusion or restriction of individually unrecipitve foods, fatty, fried foods), work and rest, exercise. Alcohol consumption is prohibited. Sanatorium treatment after surgery with stable remission (Morshyn, Truskavets, Svalyava, Caucasian Mineral Waters, Berezovsky Mineral Waters, Mirgorod, Kuyalnik). Complications of surgical treatment of housing and communal services at a long stage of rehabilitation are manifested by various dysfunctions [1]. In scientific sources, the term "Postcholecystectomy syndrome" is found. Patients complain of abdominal pain and dyspeptic symptoms after cholecystectomy [2]. Analyzing the complaints and complications with which the patients of laparoscopic cholecystectomy are treated in a long period for undergoing sanatorium-resort treatment, it becomes clear that the issue of rehabilitation of such patients is quite relevant and not fully resolved [3].

### AIM

Determine the effectiveness of the impact of mineral medicinal water of well No. 3-k. with. Goreshnee Stryisky district of Lviv region in a dilution of 3,0-3,4 g/dm<sup>3</sup> for the functional state of the liver of patients after laparoscopic cholecystectomy in a long period of rehabilitation in the conditions of the Morshynkurort health resort complex (MHRC).

### MATERIALS AND METHODS

**Materials.** An analysis of 100 medical records of patients after laparoscopic cholecystectomy who were undergoing rehabilitation at the Morshynkurort sanatorium complex in 2017 and 2018 was carried out. Women – 66 patients, men – 34 patients. The average age of the patients was 53±2,3 years. The patients consumed diluted mineral medicinal water (DMMW) from well No. 3-k. with. Verkhnee Stryisky district of Lviv region in a dilution of 3,0-3,4 g/dm<sup>3</sup> for internal use. DMMW is a product of dilution in certain proportions of underground brines svr. No. 3-k and underground waters of the source No. 4 in Morshyn for mineralization 3,0-3,4 g/dm<sup>3</sup>. Inclusion criteria: patients after laparoscopic cholecystectomy from 1 month to 1 year after surgery. Exclusion criteria: patients with contraindications to the use of the specified DMMW, namely, with the following nosologies: exacerbation of the inflammatory process in the stomach and duodenum; exacerbation of the inflammatory process in the pancreas, chronic enteritis and colitis of the acute phase of severe form; acute pyelonephritis; malignant diseases of the digestive system; violation of the passage of food masses through the gastrointestinal tract; complicated urolithiasis; circulatory insufficiency is sharply expressed.

**Methods:** Medical records were selected by a randomized method using the Random Allocation Rule program. Blinded evaluators while processing medical records. The method of comparison of indicators of the functional state of the liver of patients before the beginning of rehabilitation and after its

completion was carried out by the method of mathematical statistics – Student's t-test. The studied parameters: total protein (g/l), thymol test (u), total protein, activity of alanine transpeptidase (ALT, mmol (tsp)), aspartate transaminase (AST, mmol (tsp)), total cholesterol (mmol/l), triglycerides (unit l), blood sugar. All patients were examined before and after treatment. There was no dropout from the study among the surveyed. The average course of treatment was 15,2±0,83 days.

The methods used for the study were approved by the moral commission of the Ivano-Frankivsk Medical University (IFMU) when planning complex research work, approved by the decision of the Academic Council of the IFMU Minutes No. 19 dated 20.12.2018. on the topic: "Development and improvement of the organizational and methodological foundations of physical therapy in patients with diseases of the abdominal cavity and nervous system" (state registration number 0119U000448) and scientific research of the IFMU in the field of health in specialty 227 "Physical therapy": "Theoretical and methodological foundations of physical therapy of patients after laparoscopic cholecystectomy" (state registration number 01119 U 2951).

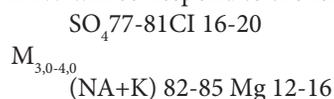
### RESULTS

Mineral brines from the Ninivsk deposit began to be used at MHRC after the State Administration (SA) "Ukrainian Research Institute of Medical Rehabilitation and Balneology of the Ministry of Health of Ukraine) in 2008-2012 with the participation of certified laboratories for the study of sanitary bacteriological salt. For the purpose of practical application, the corresponding medical reports and instructions were formed, approved by the Academic Council of the State Institution "Ukrainian Research Institute of Medical Rehabilitation and Balneology of the Ministry of Health of Ukraine" Minutes No. 5 dated February 28, 2012.

To obtain mineral diluted waters of various salt concentrations, brines were diluted with groundwater from the Morshyn spring No. 4, characterized as low-mineralized chloride-hydrocarbonate magnesium-sodium-calcium (or complex cationic composition) without specific components and properties. on natural mineral table waters. Macrocomponent composition of groundwater source. No. 4, Morshyn is presented in table 1 [4].

Possibility of using groundwater. No. 4 for obtaining DMMW does not deny the current regulatory documents, provided that low-mineralized waters are used in their natural state without any additional processing [4].

The performed calculations established that when diluting the brines of the well No. 3-k with groundwater sources No. 4 in the proportions of 1: 41,69-1: 41,55; 1: 18,16-1: 21,29; 1: 8,11-1: 10,42; 1: 4,98-1: 6,50 diluted mineral waters with a salinity of 4,0 g/dm<sup>3</sup>, respectively; 6,5-7,5 g/dm<sup>3</sup>; 13,5-4,5 g/dm<sup>3</sup>; 20,5-22,0 g/dm<sup>3</sup>. When diluting brines svr. No. 3 - to the low-mineralized water of the source No. 4 in a proportion from 1: 41,69 to 1: 41,55, the chemical composition of the DMMW will correspond to the following formula:



**Table 1.** Macrocomponent composition of groundwater source No. 4, Morshyn

| CATIONI, MG / DM <sup>3</sup>   |                  |                  | ANIONI, MG / DM <sup>3</sup> |                               |                               | MINERALIZATION, G / DM <sup>3</sup> | THE FORMULA OF THE CHEMICAL COMPOSITION OF WATER |
|---------------------------------|------------------|------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------------|--|
| Na <sup>+</sup> +K <sup>+</sup> | Ca <sup>2+</sup> | Mg <sup>2+</sup> | Cl                           | SO <sub>4</sub> <sup>2-</sup> | HCO <sub>3</sub> <sup>-</sup> |                                     |  |
| 17,5                            | 16,0             | 5,5              | 14,2                         | 14,8                          | 79,3                          | 0,15                                | HC03 65 Cl 20 SO 415<br>CA 40 (NA+K) 38 Mg 22    |

**Table 2.** Estimated limits of fluctuations in the content of macrocomponents in the DMMW with mineralization 3,0-4,0 g/dm<sup>3</sup>

| CATIONI, MG / DM <sup>3</sup>   |                  |                  | ANIONI, MG/DM <sup>3</sup> |                               |                               | MINERALIZATION, G/DM <sup>3</sup> |
|---------------------------------|------------------|------------------|----------------------------|-------------------------------|-------------------------------|-----------------------------------|
| Na <sup>+</sup> +K <sup>+</sup> | Ca <sup>2+</sup> | Mg <sup>2+</sup> | Cl                         | SO <sub>4</sub> <sup>2-</sup> | HCO <sub>3</sub> <sup>-</sup> |                                   |
| 0,84-1,13                       | 0,02-0,04        | 0,06-0,12        | 0,25-0,43                  | 1,71-2,22                     | 0,08-0,09                     | 3,0-4,0                           |

The given composition of DMMW characterizes it as low-mineralized sulfate, chloride-sulfate sodium. The limits of the content of basic cations and anions in DMMW with a mineralization of 3,0-4,0 g/dm<sup>3</sup> are presented in Table 2 [4].

When receiving DMMW, groundwater is used, containing standardized components and compounds within acceptable limits, therefore, their concentration in DMMW with a salinity of 3,0-4,0 g/dm<sup>3</sup>. DMMW does not contain specific biologically active components and compounds in therapeutic concentrations. The performed control physicochemical analysis of the DMMW confirmed the specified physicochemical parameters of the DMMW – total mineralization, basic chemical composition and compliance with the requirements of regulatory documents. Macrocomponent composition of DMMW svr. No. 3-k with. Burned in certain proportions of dilution are presented in Table 3 [4].

Along with hydrotherapy, a component of the rehabilitation process in patients after laparoscopic cholecystectomy was dietary nutrition, organized in the conditions of the MHRC. A feature of the diet was the presence of a normal content of proteins, fats (with an equal ratio of animal and vegetable fats) and carbohydrates. Refractory fats, cholesterol-rich foods, essential oils, spices, and extractives were excluded from the diet. The diet included vegetables and fruits. All dishes were cooked boiled or steamed or baked. For drinks, they used compotes from seasonal local fruits or compote without sugar. Butter or vegetable oil was added to prepared meals. The food was taken warm, hot and cold dishes are

excluded. Chopped diet – after 3-4 hours. Dinner – no later than 2 hours before bedtime. List of products and dishes on the menu: wheat or rye bread, uncomfortable varieties of bakery products, pastries (only yesterday's pastries or dried ones are required), dry biscuits. Soups based on vegetable or cereal broths, vegetarian, dairy, 1-2 times a week – low-fat meat soup. Meat dishes from lean meats (beef, chicken, turkey, rabbit) boiled, baked or steamed. Fish dishes from low-fat varieties of fish, boiled or baked. Cereals and pasta – rice, buckwheat, oatmeal, semolina and puddings, pasta. Dishes and side dishes from vegetables, except for legumes – boiled or stewed potatoes, carrots, beets, zucchini, pumpkin, etc. Fruits and berries – baked apples of non-acidic varieties, bananas, berry jelly, compotes, mousses. Sweets – sugar, jam, honey in moderation. Dairy products – whole milk (different fat content of milk), kefir, yogurt, low-fat cottage cheese and cheese. During the rehabilitation period, the following products were prohibited on the menu: fried foods, buns, pastries, cakes, fat meat and fish broths, mushrooms, caviar, offal, fatty meats and lard, sour cream, cream, fatty fish, canned food, smoked meats, beans and other legumes, radishes, onions, garlic, radishes, radishes, cabbage, tomatoes, cucumbers, spices, spicy dishes and seasonings, chocolate, cocoa, strong coffee, alcohol and carbonated drinks. Prohibited foods were not on the menu of organized meals at the MHRC, and we cannot be sure that the patients did not consume prohibited foods in commercial food outlets in the city of Morshyn during their rehabilitation.

**Table 3.** Macrocomponent composition of DMMW well No. 3-k s. Upper in certain proportions of dilution

| Cationi, mg / dm <sup>3</sup>   |                  |                  | Anioni, mg/dm <sup>3</sup> |                               |                               | Mineralization, g/dm <sup>3</sup> | The formula of the chemical composition of water |
|---------------------------------|------------------|------------------|----------------------------|-------------------------------|-------------------------------|-----------------------------------|--|
| Na <sup>+</sup> +K <sup>+</sup> | Ca <sup>2+</sup> | Mg <sup>2+</sup> | Cl                         | SO <sub>4</sub> <sup>2-</sup> | HCO <sub>3</sub> <sup>-</sup> |                                   |  |
| 0,999                           | 0,032            | 0,083            | 0,362                      | 1,934                         | 0,085                         | 3,50                              | pH 6,2<br>SO 78 Cl 20<br>(NA+K)84 Mg 13          |

**Table 4.** The results of biochemical pre-treatment of blood in the implantation of mineral diluted drinkable water from the Sverdlov region No. 3-k. at a concentration of 3,0-3,4 g/dm<sup>3</sup>.

| Indicator                    | Before rehabilitation<br>(M±m) | After rehabilitation<br>(M±m) | p     |
|------------------------------|--------------------------------|-------------------------------|-------|
| Total protein, (g/l)         | 60 ± 6,32                      | 68 ± 6,73                     | >0,05 |
| Thymol test, unit            | 4,23 ± 0,45                    | 2,21 ± 0,42*                  | <0,01 |
| Total bilirubin, mmol/l      | 17,85 ± 1,88                   | 15,37 ± 1,69                  | >0,05 |
| ALT, mmol (units/hour · l)   | 0,98 ± 0,11                    | 0,68 ± 0,10*                  | <0,05 |
| AST, mmol (units/hour 1 · l) | 0,46 ± 0,08                    | 0,42 ± 0,08                   | >0,05 |
| Total cholesterol, mmol/l    | 6,21 ± 0,37                    | 5,23 ± 0,32*                  | <0,05 |
| Triglycerides, mmol/l        | 2,10 ± 0,30                    | 1,29 ± 0,29                   | >0,05 |
| Blood glucose, mmol/l        | 6,20 ± 0,56                    | 5,13 ± 0,49                   | >0,05 |

\*reliability of indicators in comparison with rehabilitation –  $p < 0,05$

The results of a biochemical blood test were analyzed in 100 patients after laparoscopic cholecystectomy, who were undergoing rehabilitation at the Morshynkurort sanatorium complex in 2017, 2018 and consumed diluted mineral healing water from well No. 3-k. with Verkhnee Stryisky district of Lviv region in a dilution of 3,0-3,4 g/dm<sup>3</sup> for internal use. The method of hydrotherapy was carried out according to the instructions for practical use, approved by the Academic Council of the State Institution “Ukrainian Research Institute of Medical Rehabilitation and Balneology of the Ministry of Health of Ukraine”: amount of intake: 200-250 ml. at one time, temperature 40-42°C, 3 times a day, 40 minutes before meals.

Blood sampling for the study was carried out before the beginning of rehabilitation and after 14 days of hydrotherapy. Inclusion criteria: patients after laparoscopic cholecystectomy from 1 month to 1 year after surgery. Contraindications to the use of diluted mineral medicinal water from wells No. 3-k. with Goreshnee Stryisky district of Lviv region in a dilution of 3,0-3,4 g/dm<sup>3</sup> was the presence in patients: exacerbation of the inflammatory process in the stomach and duodenum; exacerbation of the inflammatory process in the pancreas, chronic enteritis and colitis of the acute phase of severe form; acute pyelonephritis; malignant diseases of the digestive system; violation of the passage of food masses through the gastrointestinal tract; complicated urolithiasis; circulatory insufficiency is sharply expressed. The results of a biochemical blood test of the use of diluted mineral medicinal water from well No. 3-k. At a concentration of 3,0-3,4 g / dm<sup>3</sup> are presented in Table 4 [4].

## DISCUSSION

According to the medical instructions, the indication for hydrotherapy of DMMW in the specified proportions is the presence of patients with the following diseases: chronic non-atrophic gastritis with increased and preserved acid-forming function of the stomach in the stage of unstable and stable remission; chronic atrophic gastritis with reduced and preserved acid-forming function of the stomach at the stage of unstable and stable remission; uncomplicated peptic ulcer disease in remission; uncomplicated peptic ulcer of the duodenum in remission; functional dyspepsia; chronic colitis accompanied

by diarrhea or constipation in the stage of unstable and stable remission; diverticular bowel disease without complications; irritable bowel syndrome; dysfunctional disorders of the biliary tract; other diseases of the biliary tract of various origins of unstable and stable remission; postcholecystectomy syndrome; gastric surgery syndromes; chronic viral hepatitis with minimal inflammatory processes in the liver; chronic liver disease in unstable and stable remission; chronic pancreatitis in the stage of unstable and persistent remission; diabetes mellitus; chronic pyelonephritis in remission; urolithiasis without impaired patency of the urinary tract; chronic cystitis in the stage of unstable and persistent remission; uric acid diathesis; alimentary obesity, which allows the use of this method for patients with comorbidities.

The presence of calculous cholecystitis leads to functional disorders in the liver, which are manifested by increased activity of transaminases, levels of C-reactive protein, cholesterol and other studied indicators, which persist after laparoscopic cholecystectomy. Hyperbilirubinemia develops, the genesis of which is due not only to the violation of the evacuation of bile from the extrahepatic bile ducts, but also functional changes in hepatocytes. The total amount of whey protein in patients who were in the long-term stage of rehabilitation in MHRC, despite hypoalbuminemia and hypergammaglobulinemia, is within the norm, which coincides with the work of other scientists [3, 5].

As a result of rehabilitation of patients with use in the conditions of a sanatorium hospital after 14 days of the use of the mineral diluted medical water of a well №3-k. with. Control laboratory studies were performed at a concentration of 3,0-3,4 g/dm<sup>3</sup>. Mathematical statistics revealed a significant ( $p < 0,05$ ) improvement in such indicators as: thymol test, alanine transpeptidase activity, total cholesterol. Analyzing the results of the study, it can be argued that the use of diluted mineral healing water well №3-k. with. Upper, at a concentration of 3,0-3,4 g / dm<sup>3</sup> for at least 14 days in the long-term rehabilitation phase in patients after laparoscopic cholecystectomy led to improved protein-synthesizing function of the liver – Thymol test decreased from 4,23 ± 0,45 To 2,21 ± 0,42 unit ( $p < 0,01$ ). The activity of alanine transpeptidase ALT decreased, from 0,98 ± 0,11 to 0,68 ± 0,10 units/hour · l, ( $p < 0,05$ ), which indicates the recovery of liver cells. There was

a statistically significant ( $p < 0,05$ ) decrease in total cholesterol from  $6,21 \pm 0,37$  to  $5,23 \pm 0,32$  mmol/l. Of course, current trends in the development of rehabilitation require not only a medical, biological approach to the recovery of patients, but also psychosocial. However, it can be argued that the inclusion of hydrotherapy according to this scheme leads to improved liver function. Therefore, in our further research, to develop and improve the tactics of rehabilitation of patients after laparoscopic cholecystectomy at a long stage of rehabilitation along with physical therapy, occupational therapy, we will recommend, based on these studies, hydrotherapy DMMW svr. №3-k and groundwater source №4 Morshyn in dilution to mineralization  $3,0-3,4$  g/dm<sup>3</sup>.

## CONCLUSIONS

Hydrotherapy for 14 days DMMW svr. №3-k and groundwater source №4 city Morshyn in dilution to mineralization of  $3,0-3,4$  g/dm<sup>3</sup> in the long-term stage of rehabilitation leads to improved liver function of patients after laparoscopic cholecystectomy.

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# Laser Therapy in the Comprehensive Program of Physical Rehabilitation of Athletes with Chronic Patellar Tendinopathy

## Laseroterapia w kompleksowym programie rehabilitacji fizycznej sportowców z przewlekłą tendinopatią rzepki

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### SUMMARY

**Aim:** Determining the effectiveness of the developed comprehensive physical rehabilitation program for athletes with chronic patellar tendinopathy.

**Materials and Methods:** Participants were randomly divided into the main and control groups consisting of 11 people each. The complex rehabilitation program in the main group combined laser therapy and different types of therapeutic exercises, in the control group the laser therapy was excluded. The effectiveness of the intervention was evaluated by the intensity of pain in the patella (Visual Analog Scale) and the functional ability of the knee (VISA-P scale).

**Results:** At the end of the intervention, a significant reduction in pain was observed in both groups. The average scores on the VAS scale were reduced to 2.0 points in the main group and to 3.5 in the control one. The share of patients, whose pain was eased, was 27.27 per cent in the main group, in the control group such people were not detected. After two months of intervention according to the results of the VISA-P scale in both study groups, there was an improvement in the functional capacity of the knee joint. Thus, the average number of points increased by 30.5 points in the main group, and by 12.0 in the control one.

**Conclusions:** The use of high-frequency laser therapy in a comprehensive program of physical rehabilitation of patients with patellar tendinopathy shows better results for reducing pain and improving the functioning of the knee joint than without it. We believe that high-frequency laser therapy can be used as an important adjunct to various types of therapeutic exercises in the comprehensive rehabilitation of patients with patellar tendinopathy.

**Key words:** high-frequency laser therapy, exercise, jumper's knee

**Słowa kluczowe:** laseroterapia wysokoczęstotliwościowa, ćwiczenia, kolano skoczka

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### INTRODUCTION

Knee injuries are the most common among sports injuries of the lower extremities in athletes of various sports. This is due to the high load on the joint when jumping and running in training and competition and to the features of the anatomical structure and biomechanics of movements in the knee joint [1-3]. The most common among the types of lower extremities tendinopathy is patellar, especially among elite athletes [4-6]. Signs of patellar tendinopathy can appear after the end of a sports career, and among people who are professionally involved in significant physical activity, and among those who are at risk of developing tendinopathy due to the peculiarities of the connective tissue. Nowadays, it is

believed that this disease occurs due to microtrauma of the tendon-ligament apparatus, which leads to changes in cells and destruction in the extracellular matrix [7].

The main problem of patellar tendinopathy is pain during exercise, but there is still no clear evidence of the aetiology and mechanisms of this pain. And this leads to the existence of different approaches to the treatment and physical rehabilitation of patients with patellar tendinopathy (PT). In physical rehabilitation programs, therapeutic exercises are most often combined with either extracorporeal shock wave therapy [8] or with platelet-rich plasma (PRP) injections or with steroid injections [9, 10]. There are works devoted to the study of low-intensity laser therapy (LILT) or high-

intensity laser therapy (HILT) in tendinopathy [11, 12], the combined effects of laser therapy, and certain types of therapeutic exercises [11, 13, 14] in patellar tendinopathy. No work has been found that studies the combination of laser therapy with different types of therapeutic exercises in one rehabilitation program.

### AIM

To substantiate and develop a comprehensive physical rehabilitation program for athletes with chronic patellar tendinopathy, combining different types of therapeutic exercises and high-frequency laser therapy, and experimentally test its effectiveness.

### MATERIALS AND METHODS

The study protocol meets the requirements of European bioethics and bio-rights approved by the Helsinki Declaration of the World Medical Association (2008). Written informed consent was obtained from each participant before the start of a comprehensive physical rehabilitation program. The study was conducted from June to September 2021.

The study involved 22 people, all men aged 20 to 35 years. Participants were selected according to the following criteria:

- morphological changes in the tendon confirmed by ultrasound;
- complaints of pain (painfulness) in the lower pole of the patella for at least 2 years;
- presence of conservative treatment in the anamnesis, which did not give a positive result;
- at least an intensive 6-year term of sports;
- availability of sports training or end of sports career not more than a year ago;
- absence of other injuries and diseases of the lower extremities.

Study participants are engaged in athletics (5 people), handball (6 people), football (10 people), basketball (1 person). Participants were randomly divided into two groups of 11 people: the main group, whose participants performed a comprehensive program of physical rehabilitation in full (laser therapy and therapeutic exercises), and the control group, whose participants performed only therapeutic exercises.

The general characteristic of participants of the complex program of physical rehabilitation is given in Table 1.

The comprehensive rehabilitation program for the main group included laser therapy, various types of therapeutic exercises, post isometric relaxation for the muscles of the lower extremities. The control group was engaged in a similar program, but without laser therapy. The program included four stages with a total duration of 2 months.

A high-intensity BTL-6000 laser (P6000.402) with a maximum power of 12 W in the constant mode and a wavelength of 1064 nm was used for laser therapy. Patients in the main group received laser irradiation of the patellar ligament in two stages over four weeks. The first stage was performed for two weeks, every other day, and included procedures to pain manage the affected area. There were 8 sessions according to the program L-7133 [15] with a power of 10 W, a frequency of 25 Hz, a fill factor (FF) of 25 per cent, a therapeutic radiation dose of 12 J/cm<sup>2</sup>, a duration of 4 minutes, a nozzle size of 30 mm. The procedure began at a distance of 5-7 cm from the area of maximum pain, followed by approaching the centre of the lesion. The second stage was also being performed for two weeks, every other day, and included procedures for biostimulation of the tissues of the patella. Eight sessions were performed according to the program L-7134 [15] with a power of 12 W, constant frequency and fill factor (FF), therapeutic radiation dose up to 140 J/cm<sup>2</sup>, duration of 6 minutes, nozzle size 30 mm. In this phase of treatment, only the area of pathology and adjacent areas were treated.

Characteristics of therapeutic exercises according to the stages of a comprehensive rehabilitation program are shown in Table 2.

The effectiveness of the intervention was evaluated by the intensity of pain in the patella and the functional ability of the knee during normal and sports motor activity. Before and at the end of the comprehensive physical rehabilitation program, pain intensity was assessed on a ten-point Visual Analog Scale; the functional ability of the knee – on the scale of VISA-P [16], Ukrainian version [17].

Data were expressed as mean ± standard deviation. The probability of difference was assessed by t-test. The statistical

**Table 1.** General characteristics of the main and control groups of athletes with patellar tendinopathy (M ± σ)

| Indicators                              | Main group (MG) | Control group (KG) | The difference between athletes MG and KG |
|---|-----------------|--------------------|---|
| Age, years                              | 26.7±5.43       | 27.2±5.08          | p≥0,05                                    |
| Height, cm                              | 182.3±7.24      | 179.17±7.92        | p≥0,05                                    |
| Weight, kg                              | 78.8±12.25      | 78.0±7.53          | p≥0,05                                    |
| Body Mass Index                         | 22.19±2.27      | 22.32±2.35         | p≥0,05                                    |
| Number of training session per week     | 5.7±0.48        | 5.83±0.39          | p≥0,05                                    |
| Duration of one training session, hours | 2.1±0.32        | 2.13±0.31          | p≥0,05                                    |
| Sports experience, years                | 9.6±2.63        | 9.25±2.53          | p≥0,05                                    |

**Table 2.** Characteristics of a comprehensive program of physical rehabilitation for patellar tendinopathy for the main group

| Nº | Stage                                    | Intervention   | Dosage  |
|----|--|--|---|
| 1  | Gentle<br>2 weeks                        | HILT of pain management  | Program L-7133 [15], every other day, 8 procedures    |
|    |  | Fascial manipulations, post isometric relaxation (PIR) Static exercises in the antigravity position of the patient's body.   | Musculoskeletal groups of the lower extremity.        |
| 2  | Stabilizing<br>2 weeks                   | HILT<br>Biostimulation   | Program L-7134 [15], 3-4 times a week, 6-8 procedures |
|    |  | Stabilizing eccentric exercises to restore the pattern of movement. Stretching and strength exercises  | 1 hour, every day, 12 practices                       |
| 3  | Gentle-training<br>2 weeks               | Integrative kinesiotherapy.<br>Dynamic stretching eccentric exercises on block simulators with the unloading of joints, in initial positions with additional points of resistance without axial loading. | 12 sessions, 1-1.5 hours                              |
|    |  | PNF-neuromuscular reduction of motor stereotype  | 1 hour, 6 sessions a day                              |
| 4  | Training,<br>Return to sports<br>2 weeks | Integrative kinesiotherapy.<br>Complex coordination eccentric and concentric exercises on block simulators, including imitating elements of sports exercises of professional orientation.                | 12 sessions, 1 hour, every day                        |

significance level was set at  $p < 0.05$ . All statistical analyzes were performed using the STATISTICA 6.0 package.

## RESULTS

At the beginning of the rehabilitation process, the difference in the indicators of the main and control groups on the VAS and VISA-P scales was improbable ( $p \leq 0.05$ ) (Tables 3 and 4). At the end of the intervention, a significant reduction in pain was observed in both groups ( $p \leq 0.05$ ). The average scores on the VAS scale were reduced to 2.0 points in the main group and to 3.5 in the control one. The percentage decrease was 71.01 per cent and 50 per cent, respectively. The proportion of patients who were eased of pain was 27.27 per cent (three people) in the main group, in the control group such people were not detected.

After two months of intervention according to the results of the VISA-P scale in both study groups, there was an improvement in the functional capacity of the knee joint. Thus, the average

number of points increased by 30.5 points in the main group, and by 12.0 in the control one. The percentage increase was 53.14 per cent and 21.0 per cent, respectively.

## DISCUSSION

For the correct setting of the goals of our comprehensive program of physical therapy, according to the recommendations of scientists and specialists in physical and rehabilitation medicine, we used the SMART format [18]. Short-term goals were set such as relieving local pain during the day; removal of possible muscle spasms during the first stage of the physical rehabilitation program. The long-term goals of the program were to restore the pattern of movement, recover muscle strength, adapt to physical activity and recovery of physical performance, return to sports. During the first and second stages of rehabilitation, intense physical activity was excluded. In the first stage, the main focus was on pain reduction. The second stage of the program is to restore the pattern of movement, which includes

**Table 3.** Changes in VAS score before and after rehabilitation in the main and control groups, in points ( $M \pm \sigma$ )

| Group         | Before rehabilitation | After rehabilitation | $\Delta$ (before – after) |
|---------------|-----------------------|----------------------|---------------------------|
| Main group    | 6.9±0.74              | 2.0±0.99*„           | -4.9                      |
| Control group | 7.0±0.74              | 3.5±0.60*            | -3.5                      |

\* $p \leq 0.05$  – probability of difference before and after rehabilitation

« $p \leq 0.05$  – the probability of the difference before and after rehabilitation between the main and control groups

**Table 4.** Changes in VISA score of rehabilitation in the main and control groups, in points ( $M \pm \sigma$ )

| Group         | Before rehabilitation | After rehabilitation | $\Delta$ (before – after) |
|---------------|-----------------------|----------------------|---------------------------|
| Main group    | 57.4±9.37             | 87.9±7.48*„          | +30.5                     |
| Control group | 57.67±6.12            | 69.67±4.16*          | +12.0                     |

\* $p \leq 0.05$  – the probability of the difference between before and after rehabilitation in each group

« $p \leq 0.05$  – the probability of the difference before and after rehabilitation between the main and control groups

the correctness of the exercises under the supervision of a physical therapist and their application in everyday life. The third stage involves the transition from pain and limitation in the movement to the strengthening of the entire kinetic chain and the elimination of motor dysfunction. It covers several factors, including strength, range of motion, joint flexibility, motion control and biomechanics. The fourth stage is final, its main task is to fully restore efficiency and return the patient to sports. However, depending on the complexity of the lesion and the individual characteristics of the disease, some methods of a rehabilitation program may be of prolonged usage and employed at different stages of the training process.

For the selection of therapeutic exercises focused on systematic reviews [19-21 and others] and original articles [22-24].

The results of this study suggest that the combination of therapeutic exercises with high-intensity laser therapy (HILT) has a better effect on the functional capacity of the knee joint and better reduces pain than the use of therapeutic exercises alone. There are studies of the effects of both HILT and low-intensity laser therapy (LILT) on tendon pain. The use of HILT in our study is related to the study of Kaydok E. et al. [25], which showed that the use of HILT is more effective in tendinopathy than LILT.

The effectiveness of a comprehensive physical rehabilitation program in patients with patellar tendinopathy was evaluated on the known and frequently used VAS and VISA-P scales [20, 26]. Both scales assess pain. VAS allows you to assess the effectiveness, and VISA-P – the presence and intensity of pain in various daily and sports movements. It should be noted that laser therapy had a more significant effect on pain intensity. This is evidenced by the percentage range of changes in patients in the main group: on the VAS scale, pain intensity decreased by 71.01 per cent, and on the VISA-P scale – by 53.14. This is also evidenced by a comparison of changes in the VAS scale in the studied main and control groups, 71.01 per cent and 50 per cent, respectively. In addition, the vast majority of patients in the main group (81.8 per cent, 9 of 11 people) noted a short-term reduction or absence of pain during normal motor activity after the first laser therapy.

The results on the functioning of the knee joint on the VISA-P scale confirm the better effect of combining therapeutic exercises with laser therapy than without it. At the end of the study, we had 32.14 per cent higher scores in the survey of patients in the main group compared with patients in the control group. The result on the VISA-P scale increased by an average of 30.5 points. Similar changes were obtained in a study on the use of laser therapy of varying intensity [11, 12].

## CONCLUSIONS

The use of high-frequency laser therapy in a comprehensive program of physical rehabilitation of patients with patellar tendinopathy shows better results for reducing pain and improving the functioning of the knee joint than without it. The researchers believe that high-frequency laser therapy can be used as an important adjunct to various types of therapeutic exercises in the comprehensive rehabilitation of patients with patellar tendinopathy.

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Info



**POPE JOHN PAUL II STATE SCHOOL OF HIGHER EDUCATION  
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CHALLENGES AND DILEMMAS IN PHYSIOTHERAPY  
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The aim of the conference is to exchange views and experiences on contemporary challenges and dilemmas of physiotherapy over population health with special focus on postural defects and scoliosis.

**Thematic sessions:**

1. Body structure and posture of children, adolescents and adults (epidemiology and etiology of postural defects).
2. Physiotherapy in the diagnosis and treatment of postural defects.
3. Specific physiotherapy and its effectiveness in the treatment of scoliosis.
4. Varia.

**Workshops**

The conference will include workshops on the FITS method (Functional Individual Therapy of Scoliosis).  
The workshop will be conducted by Andrzej M'hango, the co-author of the method.

The papers will be presented in Polish, Russian or English in thematic sessions and the poster session.

The presentation time in each session is 15 minutes.

The application with an abstract should be sent via e-mail by 31 March 2022.

The abstract written in Polish and English should be between 150 and 250 words and should include: the aim of the research, materials and methods, results, conclusions, and key words.

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# Effectiveness of Means of Restoring the Working Capacity of Employees of the Security and Defense Sector in the Conditions of Rehabilitation After Injury

## Skuteczność metod rehabilitacji umożliwiających powrót do pracy pracownikom sektora bezpieczeństwa i obronności po urazie

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### SUMMARY

**Aim:** To determine the effectiveness of means of restoring the physical performance of employees of the security and defense sector in the conditions of rehabilitation after injury.

**Materials and Methods:** Determining the effectiveness of means of restoring physical performance of employees included conducting a survey of representatives of various structural units of the National Police and the State Security Administration of Ukraine, who were injured while on duty and were rehabilitated (n=167). The questionnaire was developed by the authors and encompassed a number of questions related to the conditions, features of injuries, the use of means of restoring working capacity and their effectiveness.

**Results:** The most common types of injuries suffered by employees while performing service duties were identified, such as: injuries of the upper and lower extremities – 60.5%; head injuries – 2.6%; torso, spine, internal organs – 16.9%. It was found that exercises of therapeutic physical culture, pharmacological agents, namely warming, painkillers, and anti-inflammatory drugs (73.8%) and therapeutic and wellness massage (48.3%) are highly effective. The average effectiveness showed the ultrasound therapy (48.6%), hydrotherapy (42.3%). Approximately the same number of employees surveyed share the effectiveness of psychological recovery means as high (34.23%), medium (35.1%) and low (30.7%).

**Conclusions:** The effectiveness of restoring the physical performance of law enforcement personnel through the use of exercises of therapeutic physical culture, pharmacological, physical and psychological means has been established.

**Key words:** physical and psychological rehabilitation, working capacity, law enforcement personnel, service duties

**Słowa kluczowe:** rehabilitacja fizyczna i psychologiczna, zdolność do pracy, służby porządkowe, obowiązki służbowe

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### INTRODUCTION

The profession of an employee of the security and defense sector of Ukraine refers to the types of activity that are determined by their extreme character. This is due to the need to ensure public safety and order, as well as the protection of people during various mass events that involve contacting aggressive people; performing service duties in the areas of conflict situations; forceful detention of offenders, etc. [1, 2]. It is not uncommon for law enforcement personnel to be injured while performing service duties. The resulting injuries are characterized by different etiologies, they differ

in severity, require medical care, and subsequently special rehabilitation, the use of appropriate means of restoring working capacity [3, 4].

The analysis of publications has shown the existence of a significant number of scientific papers devoted to the study of the peculiarities of rehabilitation and the use of various means of restoring the working capacity of specialists of various specialties, and to the search for ways for its improvement [5-7]. Rehabilitation is the use of physical exercises and psychological techniques, natural factors in the complex process of restoring people's health, psychophysical state and working capacity for

therapeutic and preventive purposes [6]. In the scientific literature, the concept of „recovery” is understood as the process of transferring the life support system to a new, higher level of energy capabilities. Scientists classify the means of restoring the working capacity by the direction and mechanism of action, as well as by the time and conditions of use. There are means of urgent, current and preventive recovery [7].

Depending on the injuries received and their severity, various means of rehabilitation and restoration of working capacity are used. In particular, during the rehabilitation of law enforcement personnel, exercises of therapeutic physical culture, complexes of medical and biological, as well as psychological means of recovery are effective [8].

Scientists state that significant factors that lead to injury of law enforcement personnel are neglecting personal safety measures, a state of fatigue, and insufficient care. „Fatigue” is interpreted as a set of temporary changes in the physiological and psychological state of a person, which appear as a result of strenuous or prolonged work and lead to a deterioration in its quantitative and qualitative indicators or even accidents [9]. Functional changes in the body during fatigue are mainly localized in those areas of the body that experience the greatest load. The development of fatigue during physical and mental work is not fundamentally different. However, when you are tired of mental activity, the most pronounced functional changes can be traced in the central nervous system [10].

Scientists identify several types of fatigue that can be caused precisely by the specifics of the official activities of employees of the security and defense sector of Ukraine, namely: acute and chronic; general and local; hidden and explicit; compensated and uncompensated [11]. In the case of constant exposure to stimuli on the body of the law enforcement officer, there is a manifestation of chronic fatigue, which over time can lead to irreversible changes. That is, chronic fatigue is the result of systematic under-recovery after official duties (excessive number of daily shifts and insufficient sleep during these shifts, irregular working day, week, etc.). During long-term under-recovery, the working capacity and resistance of the body to various diseases gradually decreases, the emotional stability of the employee also decreases, which negatively affects the effectiveness of official activity and can lead to injury.

So, the analysis of literature sources has shown that a significant number of publications are devoted to the study of the influence of negative factors of official duties on the effectiveness of performing tasks by law enforcement officers, manifestation of fatigue and shifts in their psychophysical state. At the same time, the effectiveness of means to restore the physical performance of employees in the conditions of rehabilitation after injuries has been studied insufficiently, which determined the relevance of our research.

### AIM

The aim is to determine the effectiveness of means of restoring the working capacity of employees of the security and defense sector in the conditions of rehabilitation after injury.

## MATERIAL AND METHODS

Determining the effectiveness of means to restore the working capacity of representatives of the security and defense sector provided for conducting a survey. The survey involved law enforcement officers of various structural divisions of the National Police and the State Security Administration of Ukraine, who were injured and were undergoing rehabilitation while performing service duties, namely: Patrol Police (n=46), Criminal Police (N=38), Special Purpose Police (n=32), District Police Inspectors and Community Police Officers (29), employees of the State Security Administration of Ukraine (n=22). A total of 167 law enforcement officers took part in the survey. The questionnaire was developed by the authors and provided for a number of questions related to the conditions, specifics of injuries, and peculiarities of using the means of restoring physical performance. The questionnaire was assessed by the experts in this field (4 professors and 9 associate professors) and was approved by the Academic Council of the National Academy of Internal Affairs (Protocol No. 1 dated 21.01.2017). The study of the effectiveness of means of restoring the working capacity of employees during rehabilitation was carried out on the basis of the survey results analysis. The research methods involved the analysis, synthesis, generalization, questionnaires, observations, methods of mathematical statistics.

The research was conducted in 2018-2021 and was carried out in accordance with the requirements of the Regulations on academic integrity at the National Academy of Internal Affairs. This document was approved by the Academic Council of the National Academy of Internal Affairs (protocol No. 5 of 27.03.2018) and put into effect by order of the rector of the Academy (Order No. 422 of 30.03.2018). Prior consent to participate in the study was obtained from all respondents.

## RESULTS

Based on the analysis of appeals from representatives of the security and defense sector of Ukraine to departmental health care institutions and having processed the results of the survey, the types of injuries received were established and the conditions that preceded the injury were determined. The survey showed that law enforcement officers addressed medical institutions mainly in case of moderate and high-severity injuries. Treatment of injuries, minor injuries (sprains, bruises, etc.) and rehabilitation after them were carried out by employees mostly independently, without contacting medical institutions.

Processing the answers to the questionnaire questions: “Did you feel tired while performing service duties that led to injury” – showed that 69.4% of injured employees felt tired and had a decrease in the level of physical performance while performing service duties; 30.9% of employees who were injured felt quite normal, the state of fatigue was not stated.

The question: “What, in your opinion, were the causes of injuries while performing service duties” – received an answer of 42.3% of people that they were not sufficiently focused and attentive in the conditions that preceded the injuries; 39.5% of employees stated that they were injured due to a combination of factors that didn’t depend on them (unexpected danger, adverse weather conditions, insufficient illumination of the area, etc.);

18.2% agreed with the statement that they neglected personal safety measures.

Answers to the questionnaire questions: "Under what circumstances were you injured" – showed that 28.5% of employees were injured during the public safety and order protection and mass events, of which 7.2% focused on the numerical superiority of offenders; 12.3% – on limited space; 5.1% – noted a violation of the integrity and fixation of equipment; 3.9% noted "other" reasons (insufficient level of physical and tactical readiness for the conditions that have developed). 63.8% of injuries of various degrees of complexity were received by employees of the security and defense sector during the detention of offenders. At the same time, 24.5% of injuries occurred as a result of attacking actions of offenders using improvised means; 4.2% – from an attack using cold and firearms; 6.7% – from traumatic weapons; 8.1% – during hand-to-hand combat; 20.3% – other. Among the reasons for receiving such injuries, 43.6% of injured employees stated a high level of technical and physical fitness of offenders; 32.1% – referred to an unexpected attack by the offender; 14.2% – noted adverse weather conditions, insufficient illumination of the area; 10.1% – "other" reasons. It is established that 1.3% of injuries to employees occur due to the consequences of road accidents; 6.4% – other causes (during training in working hours; unsuccessful movements, overcoming various obstacles, etc.). Preliminary diagnoses that were made to employees of the security and defense sector when they addressed medical institutions, and answers to the questions: "What types of injuries did you receive while performing service duties" – give grounds to identify the most common types of injuries (Table 1).

The most common injuries are injuries to the upper and lower extremities – 60.5%. Among them – 1.7% bone fractures; 4.3% – dislocations; 2.4% – sprains; 28.8% – bruises; 1.4% cuts. Among the total number of injuries, 22.6% are head injuries (craniocerebral, maxillofacial), including: 18.5% – soft tissue damage (bruises); 4.1% – hard tissue damage (fractures). Among hard

tissue injuries: 0.9% – fractures of the lower jaw; 0.3% – of the upper jaw; 1.5% – of the nasal bones; 1.4% – dental injuries.

Injuries to the torso, spine, and internal organs were received by 16.9% of employees while performing service duties. The most common were cracks and fractures of the ribs, exacerbation of pain from existing protrusions and inter-vertebral hernias. A small amount of damage was gunshot wounds and penetrating wounds with cold weapons, mainly various knives (kitchen, hunting), shivs and improvised means (screwdriver, axe).

During the rehabilitation of law enforcement officers after injuries, a complex of various means of recovery is mainly prescribed, the combination of which is determined by the severity of the lesion, the course of the treatment process, the age characteristics of the employee, etc. Based on the survey of employees, it was determined that the use of therapeutic physical culture exercises is quite effective in restoring working capacity after injury to the musculoskeletal system. 75.1% indicate high efficiency of their use, 18.4% – average; 6.5% – low.

The effectiveness of pharmacological agents, in particular warming, analgesic and anti-inflammatory drugs according to 73.8% of respondents is high, 20.9% – average, 5.3% – low; the effectiveness of the use of vitamin complexes and biologically active substances, according to respondents, was distributed as follows: 26.7% consider it low, 39.5% – average, 34.3% – high (Table 2).

Among the complex of physical means we have distinguished: ultraviolet radiation, ultrasound therapy, hydrotherapy (shower, bath), sauna, massage. 82.1% of the surveyed law enforcement officers consider the effectiveness of using ultraviolet radiation to be low, 13.7% – medium and 4.2% – high. The impact of ultrasound therapy as a means of recovery for 28.5% of the surveyed law enforcement officers is low, for 48.6% – medium, and for 22.9% – high. Similar dynamics is observed regarding the effectiveness of hydrotherapy agents, which provides for temperature, chemical and mechanical methods of exposure

**Table 1.** Injuries received by law enforcement officers while performing service duties, %

| No.    | Types of injuries                                 | %    |
|--------|---|------|
| 1.     | Injuries to the upper and lower extremities       | 60.5 |
| 1.2.   | - fractures                                       | 1.7  |
| 1.3.   | - dislocations                                    | 4.3  |
| 1.4.   | - sprain of ligaments                             | 24.3 |
| 1.5.   | - bruises   | 28.8 |
| 1.6.   | - cuts  | 1.4  |
| 2.     | Head injuries (craniocerebral, maxillofacial)     | 22.6 |
| 2.1    | - with soft tissue damage (bruises)               | 18.5 |
| 2.2    | - with damage to hard tissues (fractures)         | 4.1  |
| 2.2.1. | - lower jaw                                       | 0.9  |
| 2.2.2. | - upper jaw                                       | 0.3  |
| 2.2.3. | - nose bones                                      | 1.5  |
| 2.2.4. | - dental injuries                                 | 1.4  |
| 3.     | Injuries to the torso, spine, and internal organs | 16.9 |

**Table 2.** Effectiveness of means of restoring the physical performance of law enforcement officers in the conditions of rehabilitation after injury, %

| Means of restoring physical performance  | Effectiveness |         |      |
|--|---------------|---------|------|
|  | Low           | Average | High |
| Physical exercises ( <i>therapeutic physical culture</i> )                     | 6.5           | 18.4    | 75.1 |
| Pharmacological  |               |         |      |
| - warming, analgesic, anti-inflammatory drugs                                  | 5.3           | 20.9    | 73.8 |
| - vitamin complexes, biologically active substances                            | 26.7          | 39.5    | 34.3 |
| Physical:  |               |         |      |
| - ultraviolet radiation  | 82.1          | 13.7    | 4.2  |
| - ultrasound therapy   | 28.5          | 48.6    | 22.9 |
| - hydrotherapy (shower, bath)  | 39.8          | 42.3    | 17.9 |
| - sauna  | 25.9          | 39.4    | 34.7 |
| - massage  | 8.8           | 42.9    | 48.3 |
| Psychological ( <i>psychotherapeutic, psychoprophylactic, psychohygienic</i> ) | 30.7          | 35.1    | 34.2 |

and improves blood supply to tissues, redox processes in them, helps to remove products of pathological metabolism and decay, reduce traumatic edema, post-traumatic disorders in tissues and organs. Overall, 42.3% of respondents consider the effectiveness of hydrotherapy procedures to be average, 39.8% – low and 17.9% – high. One of the simplest and most affordable means of restoring performance is a sauna and massage. It is scientifically proven that the sauna serves as an active irritant, which is aimed at preventing diseases, treating, restoring and improving the performance of tired muscles. Massage is a method of treatment and prevention, which is a set of measures of mechanical impact on various parts of the surface of the human body, performed by the hands of a masseur or special devices. This method of rehabilitation of law enforcement officers helps to recover faster from various traumatic injuries: bruises, sprains, dislocations, fractures, injuries of the menisci of the knee joint, etc.

In the conditions of rehabilitation after injuries (mainly of the musculoskeletal system), 34.7% of employees note the use of a bath as a means of high efficiency, 39.4% – as of medium, 25.9% – low. Also, 48.3% of respondents are convinced of the high effectiveness of therapeutic massage; while 42.9% and 8.8% are convinced of the medium and low effectiveness of therapeutic massage, respectively. 34.2% of employees consider psychological recovery tools (psychotherapeutic, psychoprophylactic, psychohygienic) to be highly effective, 35.1% – medium and 30.7% – low.

## DISCUSSION

To ensure the full recovery of law enforcement officers after injuries, exercises of therapeutic physical culture, complexes of various medical, biological and psychological means are used. These tools contribute to the effective restoration of energy resources, accelerate adaptation processes, and accelerate the reduction of acute manifestations of pain [12]. It is proved that pharmacological means of restoring working capacity are highly effective in rehabilitation conditions. They involve the use of drugs that help restore energy reserves, increase the body's endurance to stress conditions, including warming, painkillers and anti-inflammatory drugs. Influencing the processes of metabolism, hematopoiesis, thermoregulation,

plastic and energy resources, pharmacological agents help restore the functions of regulatory mechanisms, reduce pain after injuries, increase performance, which allows a person to accelerate the natural course of recovery [6, 8].

Scientists claim that in the conditions of rehabilitation after injury what concerns the musculoskeletal system of employees, the main place is occupied by exercises of therapeutic physical culture, which are prescribed by specialists depending on the type of injury, the course of the treatment process, age characteristics, etc. [7]. Physical means of restoring working capacity have proven themselves positively. The most common ones are: ultraviolet radiation, aeroionization, physiotherapy, cold and thermal procedures. They act through the skin by physically irritating the receptors. As a result, there is a reflex effect on the activity of the muscular system, internal organs and the central nervous system.

The effect of temperature procedures is due to their ability to irritate the skin's thermo receptors and affect the functional state of the body. Under the influence of thermal procedures, blood and body temperature increases, blood flow increases, heart rate and breathing depth increase, blood pressure changes, and sweating increases. Heat has analgesic and antispasmodic action, causing muscle relaxation and changing the body's sensitivity. Thermal procedures are used in the form of electric lighting procedures, water procedures, sauna, etc. [5]. According to scientists [10] physiotherapy procedures are quite effective, among which ultrasound therapy occupies an important place. It involves treatment with special devices that emit ultrasound waves of different frequencies and cause compression and stretching of tissues, while stimulating recovery processes. There are three types of ultrasound effects on the body: physical and chemical, mechanical and thermal. In this case, the most important thing is mechanical impact, since due to acoustic pressure, microvibrations of tissues are created and deep-located areas are massaged. The thermal effect of ultrasound therapy has a beneficial effect on blood vessels, physical and chemical – on redox processes and the synthesis of biologically active compounds.

Specialists [5, 7, 12] claim that for more effective recovery of employees after injuries, and for hygienic, restorative and

therapeutic purposes, various water procedures are used, including: shower, bath (fresh and with the addition of various substances; different temperatures). In particular, a hyperthermic bath is used to normalize the musculoskeletal system, prevent stress, repeated injuries; a galvanic bath – for inflammatory and post-traumatic conditions of the musculoskeletal system, muscle cramps, nervous diseases (helps accelerate regenerative processes, reduce pain, muscle spasms, normalize metabolic processes, etc.); electrical vibro-bath helps accelerate redox processes, remove metabolic products, etc. The obtained results confirm the conclusions of the works of scientists [13, 14].

## CONCLUSIONS

Based on the conducted research, the most common types of traumas suffered by representatives of the security and defense sector while performing service duties, the causes and conditions of their receiving have been determined. It has been found that injuries of the upper and lower extremities account for 60.5% of the total number of injuries; injuries of the head (craniocerebral, maxillofacial area) – 22.6%; torso, spine, internal organs – 16.9%.

It has been established that exercises of therapeutic physical culture, pharmacological agents, namely warming, painkillers, anti-inflammatory drugs, are quite effective, and the use of vitamin complexes and biologically active substances is slightly lower. Among the totality of physical means of restoring working capacity, the average effectiveness, according to the greater part of the respondents, is shown by ultrasound therapy, hydrotherapy. A significant number of respondents consider therapeutic and wellness massage to be an effective means of restoring physical performance. The statements of employees regarding the effectiveness of psychological means of recovery were approximately equally distributed.

Prospects for further research. We plan to study the influence of psychophysical means of recovery of working capacity of employees who have suffered knee injuries.

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# Physical Therapy for Nonspecific Pain in the Thoracic Spine

## Fizykoterapia niespecyficznego bólu kręgosłupa w odcinku piersiowym

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### SUMMARY

**Aim:** To develop and prove experimentally a rational integrated approach for using physical therapy for 30-50-year-old men suffering from pain in the thoracic spine at the training stage to achieve sustainable remission.

**Materials and Methods:** The research was conducted in the clinical sanatorium "Resort Berezovsky Mineral Waters". We observed 40 men aged 30-50 years with complaints of the thoracic spine, a stable form, which was divided into the control group (20 persons) - CG and the main group (20 persons) – MG. All patients were at the training stage of rehabilitation in the conditions of sanatorium treatment. Medical and biological methods were used: pulsometry; arterial tonometry; hand dynamometry; linear measurement method; goniometry; measurement of thoracic spine mobility; spirometry. The results of the research were processed by the method of variation statistics with the calculation of mean values, mean quadratic deviation, error of mean value, probability criterion, and reliability of difference of indicators.

**Results:** Reliable positive dynamics of the musculoskeletal system and cardiorespiratory system are established

**Conclusions:** The effectiveness of a multidisciplinary approach is proved, namely application of therapeutic exercises with resistance, elements of traction action in the water in combination with physiotherapeutic procedures, psychotherapy, and therapeutic massage for 30-50-year-old men suffering from pains in the thoracic spine at the training stage of sanatorium treatment.

**Key words:** therapeutic exercises, self-correction, multidisciplinary approach

**Słowa kluczowe:** ćwiczenia terapeutyczne, autokorekta, podejście multidyscyplinarne

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### INTRODUCTION

Chronic nonspecific pain in the thoracic spine is a common disease, especially often affecting young and middle-aged persons [1].

The problem of nonspecific back pain hasn't only medical but also social significance. The modern doctrine of this disease goes beyond any one narrow medical specialty (traumatology, neurology, orthopedics, rehabilitation, etc.), it is a disease of the whole body.

Recently, the entire arsenal of conservative and operative treatments has been used to treat and prevent back pain. Among conservative methods, one of the leading is non-drug treatments, which are currently combined under the term physical therapy [2].

Data from recent years on the effectiveness of treatment and prevention of pain in the thoracic spine [3] showed that the system of rehabilitation measures is based on the isolation of three stages. The initial stage (or stabilization period) – in the acute phase of convalescence; the main task is to relieve pain, relax and stretch the tonic muscles and

mechanically unload the vertebral column. The second stage is the developing (or mobilization period): in the subacute phase of reconvalescence, the vertebral column is mobilized, the volume of movements increases, the pathological patterns of movement are corrected and the motor activity is generally expanded. The third stage is training (reactivation period): the main force load on the back muscles is given. It is such individual programs of physical therapy that allow you to balance the muscular corset of the spine and prevent repeated episodes of exacerbation of back pain.

### AIM

The purpose of the research is to develop and prove experimentally a rational integrated approach for using physical therapy for 30-50-year-old men suffering from pain in the thoracic spine at the training stage, in sanatorium treatment, to achieve sustainable remission.

### MATERIALS AND METHODS

The research was conducted in the clinical sanatorium "Resort Berezovsky Mineral Waters". We observed 40 men

## RESULTS

aged 30-50 years with complaints of the thoracic spine, a stable form, which was divided into the control group (20 persons) – CG and the main group (20 persons) – MG. All patients were at the training stage of rehabilitation of sanatorium treatment.

The initial research was conducted by us in the first two days when patients entered the clinical sanatorium, and again at the end of the rehabilitation course.

Both groups were homogeneous in sex, age, profession, and clinical manifestations of the disease. The II-III degree of the pathological process was observed (according to an X-ray examination and examinations of a neuropathologist and an orthopedic traumatologist).

The disease age on average in the control group was  $5,2 \pm 1,4$  years, in the main –  $5,3 \pm 1,5$  years ( $p > 0,05$ ). Periods of exacerbation of the disease were observed 1-2 times a year in both groups. In acute and subacute periods (in previous stages of rehabilitation), patients of both groups received approximately the same comprehensive treatment (medication, traction, and use of physical therapy).

When patients entered the rehabilitation department of the sanatorium in both groups, there were complaints of periodically occurring back pain, which intensified in the morning after sleep or after hard physical work. When determining the pain value from the percentage score scale, patients of the control and main group rated it at 41% and 41,5%, respectively. Vertebral-neurological disorders were assessed in both groups at 7 points. When determining the standard of living according to the Oswestrovskiy questionnaire [cit. 4] in the control group patients, it was assessed at 34% and in the main group at 33%.

In addition, 46% of the main group patients and 47% of the control group patients had complaints of decreased muscle strength and volume of upper limb movements (either left or both) and spine; periodic unpleasant sensations in the heart and chest in the form of tingling, numbness, "formication".

During the external examination, 73% of patients of the control group and 74% of the main group showed asymmetry in the arrangement of scapulas and waist triangles.

With palpation, almost all patients showed soreness in the thoracic spine (Valleix pain point), restriction of the mobility of the thoracic spine, especially when unbending. Palpation also noted the presence of minor soreness of the spinous processes and Erb pain points, soreness of the muscles of the anterior and posterior surfaces of the chest, a decrease in the tone of these muscles.

Medical and biological methods were used: pulsometry; arterial tonometry; hand dynamometry; linear measurement method; goniometry; measurement of thoracic spine mobility; spirometry. The results of the research were processed by the method of variation statistics with the calculation of mean values, mean quadratic deviation, error of mean value, probability criterion, and reliability of difference of indicators [5-7].

The research was approved by Ethics Commission of National University Of Pharmacy, Kharkiv, according to the European bioethics and bio-rights, Helsinki Declaration of the World Medical Association.

The analysis of indicators in the primary goniometry research, determination of thoracic spine mobility and cardiorespiratory system function, significant differences weren't observed in both groups (Table 1).

Taking into account the detected changes in the functional state of the body systems, we have proposed a program of physical therapy for men at the training stage in the conditions of sanatorium treatment, including elements of traction exposure in the water, static exercises and therapeutic exercises for self-correction of the thoracic spine in combination with physiotherapy, psychotherapy, and massage [8-12].

The lesson began with unloading and performing a set of therapeutic water exercises ( $t = 30^{\circ}\text{C}$ ) for 15-20 minutes. Then patients performed resistance therapy exercises (15-20 minutes, and auto training (10 minutes). After that, a classic therapeutic massage was performed (10-12 minutes). That is, the duration of the lesson in the physical therapy department was first 50 minutes, then reached 60-62 minutes.

### THE METHOD OF HYDROKYNESOTHERAPY FOR PAIN IN THE THORACIC SPINE

Water exercises can be used as an independent remedy for patients with initial manifestations of disease at the vertebral pain syndrome depending on the decrease in function of a cartilaginous disk or to be applied as a supportive application in combination with orthopedic treatment and extension of a backbone [6].

Three groups of therapeutic water exercises were used: 1) free body movements; 2) pulling exercises at the side; 3) stretching and swimming movements in the water.

Free movements in the water included trunk leaning, body turning, pelvis, circular trunk movements, and hip swivels. Patients performed active exercises in a standing position at the bottom of the pool, plunging into the water to the level of the scapulas.

Exercises at the side of the pool aimed at stretching the spine included semi-sessions (the patient adhered with his hands overboard the pool), deformation of the spine in abutment on the handrail, semi-hangs on the crossbar. When fixed with his legs at the handrail, the patient attempted to "swim away" due to an arm stroke. The exercises of this group also included spring swings in semi-hangs to the side of the pool with the foot stop on its wall (with the patient's hands to hold the handrail), and hanging on the trapezoid, accompanied by foot movements (for example, folding and breeding legs). Further expansion of the spine and strengthening of the back muscles were facilitated by "sliding" in the water from a push with legs, swimming with a carpenter, and free-swimming. When using the flesh, the patient grabbed it from the side with his hands and placed the thorax on it, deforming the lumbar spine.

Therapeutic water exercises were combined with inclined and vertical stretching of the spine in the water, which played the role of a preparatory treatment measure that improves the effectiveness of traction therapy.

**Table 1.** Comparative rates of control and main group patients in the primary research

| №   | Indicator   | Stage of the research | CG, n=20          |                   | t    | p     |
|---|---|-----------------------|-------------------|-------------------|------|-------|
|   |   |                       | M±m               | M±m               |      |       |
| I. Thoracic spine mobility (according to goniometry and linear measurements)                          |   |                       |                   |                   |      |       |
| 1.  | Bending and straightening movements in the sagittal plane (cm): forward                   | I                     | <u>38,00±1,21</u> | <u>37,00±1,19</u> | 0,59 | >0,05 |
|   |   |                       | 33,00±1,14        | 34,00±1,15        | 1,62 | >0,05 |
| 2.  | Extension motions in the sagittal plane (degrees): backward                               | I                     | <u>13,00±1,02</u> | <u>12,00±1,01</u> | 0,69 | >0,05 |
|   |   |                       | 10,00±1,01        | 11,00±1,00        | 0,70 | >0,05 |
| 3.  | Front plane movements (lateral inclines) (difference in cm): to the right to the left     | I                     | <u>14,00±1,01</u> | <u>15,00±1,02</u> | 0,69 | >0,05 |
|   |   |                       | 13,00±1,07        | 12,00±1,06        | 0,66 | >0,05 |
|   |   |                       | <u>14,00±1,03</u> | <u>15,00±1,02</u> | 0,69 | >0,05 |
|   |   |                       | 12,00±1,01        | 11,00±1,01        | 0,70 | >0,05 |
| 4.  | Rotational movements in the transverse plane (difference in cm): to the right to the left | I                     | <u>50,00±2,31</u> | <u>49,00±2,22</u> | 0,31 | >0,05 |
|   |   |                       | 46,00±1,96        | 45,00±1,66        | 0,40 | >0,05 |
|   |   |                       | <u>51,00±2,24</u> | <u>50,00±2,21</u> | 0,32 | >0,05 |
|   |   |                       | 45,00±1,89        | 44,00±1,77        | 0,39 | >0,05 |
| 5.  | Schober test (modified) (cm)  | I                     | 1,20±0,12         | 1,23±0,11         | 0,19 | >0,05 |
| II. Cardiorespiratory function indicators   |   |                       |                   |                   |      |       |
| 1.  | Heart rate (bpm)  | I                     | 85,10±4,10        | 83,45±4,14        | 0,28 | >0,05 |
| 2.  | Systolic pressure (mmHg)  | I                     | 138,10±9,20       | 134,44±9,12       | 0,29 | >0,05 |
| 3.  | Diastolic pressure (mmHg)   | I                     | 84,10±4,20        | 82,28±3,81        | 0,33 | >0,05 |
| 4.  | Breathing rate (movement in min)  | I                     | 16,31±1,04        | 16,88±1,01        | 0,40 | >0,05 |
| 5.  | Mobility of inferior border of lungs (cm)   | I                     | 3,21±0,25         | 2,98±0,19         | 0,74 | >0,05 |
| 6.  | Electrocardiogram (cm)  | I                     | 4,22±0,35         | 4,01±0,28         | 0,47 | >0,05 |
| 7.  | Vital capacity of lungs (ml)  | I                     | 2689,10±110,40    | 2598,30±107,33    | 0,59 | >0,05 |
| Note: The top row is the volume of passive movements. The bottom row – the volume of active movements |   |                       |                   |                   |      |       |

Also, we included static exercises and exercises for thoracic spine self-correction in physical therapy classes for main group patients (complex 1, 2).

### COMPLEX 1 STATIC EXERCISES FOR PAIN IN THE THORACIC SPINE

Start and finish exercises by self-massaging the collar zone.

1. S.P. – standing, legs apart, hands raised to the shoulders palms up – breathe in. Tense the muscles of the back and hands, imitating the lifting of the load – breathe out. Return to the starting position, breathe and relax. Repeat the exercise 5-6 times. Exhalation should be slow, through a closed mouth slot, inhalation - through the nose.

2. S.P. – standing, legs apart, right hand raised. Change the position of your hands. Repeat the exercise 6-8 times.

3. S.P. – hands are located outside in front of the chest (bent in the elbows). Strain the muscles of the back, hands and slowly imitate repulsion with force, straightening the hands. Then with the power to spread them to the sides and back and split their fingers. Bend your hands as much as possible back and up and hold the pose 15 s. Repeat the exercise 4-5 times. Bend as much as possible in the thoracic spine. Hold the pose on semi-breath. Normalize breathing in pauses between repetitions.

4. S.P. – lying on the back, legs apart, hands to the sides, palms up. Pressing the pelvis and legs to the floor, turn the torso to the left, trying to cover the left with your right palm – hold the pose 10 s. Repeat the exercise 3 times in each direction. Turn the head towards the torso turn.

5. S.P. – lying on the back, raise his hands. Bend, lift the thoracic spine, at the same time deflecting the head back – breathe in. Hold the pose – 5 seconds. Repeat the exercise 4-5 times. Return to the initial position, relax the muscles – breathe out (5 s).

6. S.P. – lying on the back, arms extended along the body. Take a deep breath, slowly lift your head and upper torso. Start breathe out and look at your feet at semi-breath. Hold 10 s. Repeat exercise 3 times. With a tendency to hypertension, a pose should be held no more than 5 seconds.

7. S.P. – lying on the back, the right hand is located on the abdomen. Take a slow breath through the nose, simultaneously stick out the abdomen, hold your breath for 5 seconds. Slowly breathe out through the half-open mouth, pull in the abdomen. Repeat the exercise 3-4 times.

8. S.P. – lying on the abdomen, hands bent in the elbows and located at the level of the shoulders, fingers intertwined. Slowly bend back the thoracic spine and neck, raising the head and shoulders and at the same time straightening the

arms – breathe in. Hold the pose 10 s. Return to the initial position, relax – breathe out (6 s). Repeat the exercise 4-5 times. In the starting position, put the forehead on the interwoven fingers.

9. S.P. – lying on the abdomen, arms extended, fingers woven, palms outward, upper torso raised. Hands make 4 circular movements to the right, then to the left. Repeat the exercise 3-4 times.

10. S.P. – the main stand (standing straight, arms lowered along the body, legs together). Raise your hands to the sides and up, bend, pull, stand on the socks – breathe in. Throw your hands down, relax, lower your shoulders - breathe out. Repeat the exercise 3-4 times.

11. S.P. – standing, arms are in front of the chest, palms are closed, and shoulders are turned. At semi-breath, strain the muscles of the neck, back, hands and press the palm of the palm for 6 seconds. Return to the initial position, relax muscles, lower shoulders, normalize breathing (6 s). Repeat the exercise 3-4 times.

S.P. – standing, hands to the shoulder joints. Circular movements in the shoulder joints of 8 circles forward and backward.

## COMPLEX 2

### STATIC EXERCISES FOR SELF-CORRECTION OF THE THORACIC SPINE

1. S. P. – kneeling, arms rest on half. Bend your back in the chest spine as much as possible, touch your chest with your chin, look down. Hold the pose 8-10 s at semi-breath out. Bend as much as possible, look up, breathe out slowly. Hold the pose 5-6 s. Repeat the exercise 6-8 times, trying to bend as much as possible. The exercise affects the lumbar – thoracic spine.

2. S.P. – kneeling, hands rest on the forearms. Perform the exercise in the same way as the previous exercise. The exercise affects the cervical-thoracic spine.

3. S.P. – kneeling, the hands rest on half. Breathe, with your left hand stretch to the right under the right hand (6-8 seconds), moving your fingers along the floor. The arm in the stop must not bend. Return to the starting position, relax – breathe out. Repeat all movements in the other direction. Do exercises 3-4 times each way.

4. S.P. – kneeling, hands are in abutment. Breathe in, with your left hand stretch to the right under your right hand (6-8 s), moving your fingers along the floor. Right hand bend, left shoulder touch the floor. Return to the starting position, relax – breathe out (4 s). Repeat all movements 4-6 times in each direction.

5. S. P. – sitting on a chair with a strong back and without sharp corners. Put your hands on the back of the head and bend back so that the spine is pressed to the upper edge of the back of the chair. Then lean forward. Repeat 4 times (Figure 1.1).

6. S. P. – lying on the back on a solid horizontal surface, under the back in the thoracic spine, put a roller with a diameter of about 10 cm. Put your hands behind the head, lie on the roller. Bend, then lift the upper torso (Figure 1.2). When bending back – breathe in, when lifting the upper part of the body – breathe out, 3-4 times.

S. P. – sitting or lying. Wrap the bottom of the chest with a towel. Take up the free ends with your hands (Figure 1.3). After loosening the towel tension, take a deep breath. When exhaling, tighten the towel as much as possible, promoting full breathe out. Repeat 5-10 times.

A multidisciplinary approach was used in working with patients: physical procedures, traditional therapeutic massage were used in both groups daily, psychotherapist conducted psychotherapy sessions daily or every day for 40 minutes each. The 1st-4th sessions focused on correcting non-adaptive beliefs and teaching patients psychophysiological self-regulation techniques, including muscular and emotional autorelaxation techniques, ways to respond to negative emotions,

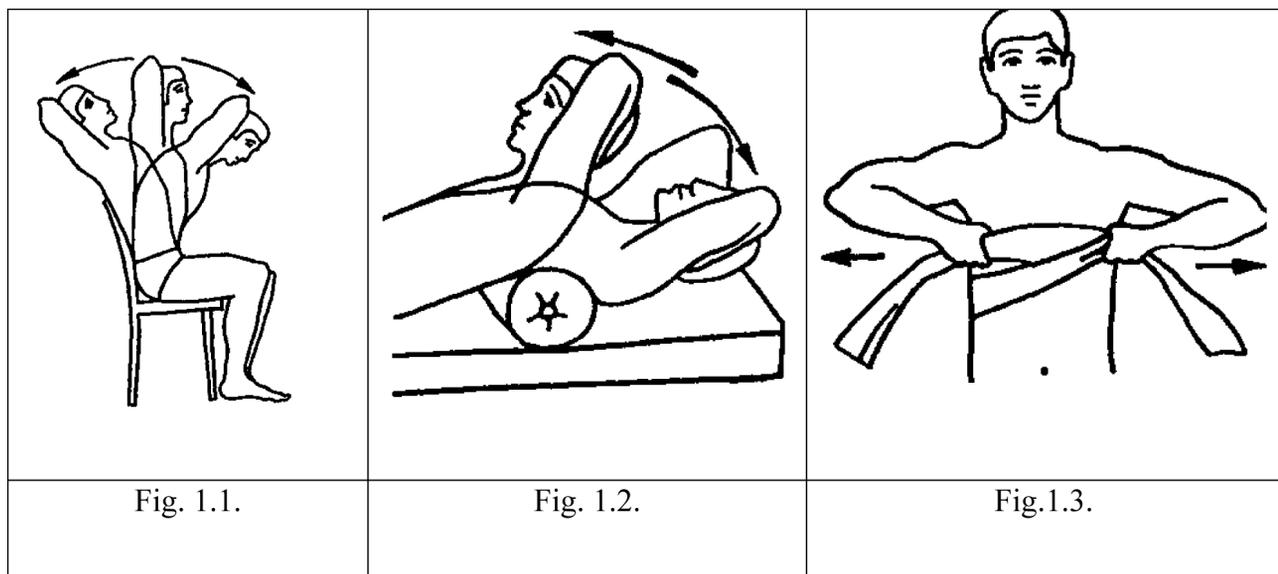


Figure 1. Static exercises and exercises for thoracic spine self-correction in physical therapy classes for main group patients

**Table 2.** Comparative dynamics of patient scores of both groups in the primary (I) and repeat (II) researches

| №  | Indicator   | Stage of the research | CG, n=20          |                   | MG, n=20 |        | t | p |
|--|---|-----------------------|-------------------|-------------------|----------|--------|---|---|
|  |   |                       | M±m               | M±m               | M±m      | M±m    |   |   |
| I. Thoracic spine mobility (according to goniometry and linear measurements) |   |                       |                   |                   |          |        |   |   |
| 1.   | Bending and straightening movements in the sagittal plane (cm): forward               | I                     | <u>38,00±1,21</u> | <u>37,00±1,19</u> | 0,59     | >0,05  |   |   |
|  |   |                       | 33,00±1,14        | 34,00±1,15        | 1,62     | >0,05  |   |   |
|  |   | II                    | <u>40,00±1,16</u> | <u>45,00±1,15</u> | 3,07     | <0,005 |   |   |
|  |   |                       | 39,00±1,18        | 43,00±1,18        | 2,40     | <0,05  |   |   |
| 2.   | Extension motions in the sagittal plane (degrees): backward                           | I                     | <u>13,00±1,02</u> | <u>12,00±1,01</u> | 0,69     | >0,05  |   |   |
|  |   |                       | 10,00±1,01        | 11,00±1,00        | 0,70     | >0,05  |   |   |
|  |   | II                    | <u>19,00±1,09</u> | <u>24,00±1,07</u> | 3,27     | <0,005 |   |   |
|  |   |                       | 18,00±1,05        | 22,00±1,08        | 2,65     | <0,01  |   |   |
| 3.   | Front plane movements (lateral inclines) (difference in cm): to the right to the left | I                     | <u>14,00±1,01</u> | <u>15,00±1,02</u> | 0,69     | >0,05  |   |   |
|  |   |                       | 13,00±1,07        | 12,00±1,06        | 0,66     | >0,05  |   |   |
|  |   |                       | <u>14,00±1,03</u> | <u>15,00±1,02</u> | 0,69     | >0,05  |   |   |
|  |   |                       | 12,00±1,01        | 11,00±1,01        | 0,70     | >0,05  |   |   |
|  |   | II                    | <u>18,00±1,09</u> | <u>20,00±1,08</u> | 1,31     | >0,05  |   |   |
|  |   |                       | 17,00±1,06        | 19,00±1,07        | 1,32     | >0,05  |   |   |
|  |   |                       | <u>19,00±1,04</u> | <u>20,00±1,01</u> | 0,69     | >0,05  |   |   |
|  |   |                       | 18,00±1,05        | 19,00±1,02        | 0,68     | >0,05  |   |   |

etc., the 5th-8th sessions focused on solving specific patient concerns, including the problem of recovery from an existing disease. At the closing session, a review of the successes and difficulties arising in patients during the training process was conducted.

Thus, patients of both groups in the rehabilitation department of the sanatorium at the training stage were for 21 days, receiving a complex of rehabilitation effects daily, but according to different methods.

## DISCUSSION

In the repeated research, after the use of physical therapy, we revealed the following dynamics of the above-described indicators in both groups: in the main group, complaints were absent in 63% of cases, in the control group – 41%. During external examination, the asymmetry of the position of scapulas and waist triangles was preserved in the main group in 22% of patients, in the control group – in 44%. With palpation, patients of the main group had practically no soreness in the thoracic spine and the muscles surrounding it, in the control group, soreness remained in 31% of patients. When determining the pain value from the percentage score scale, patients of the control and main group rated it at 33% and 13%, respectively. Vertebral-neurological disorders were rated 5 points in the control group and 3 points in the main group. When determining the standard of living according to the Oswestrovsky questionnaire [cit. 4] in control group patients, it was assessed at 23% and in the main group at 15%.

In the main group, the volume of thoracic spine movements in the sagittal plane in flexion and extension and in the frontal plane with trunk leaning, as well as in rotation, also significantly increased the value of the modified Schober test compared to the control group (Table 2).

## CONCLUSIONS

1. The multidisciplinary approach is most effective in patients with chronic nonspecific back pain from the point of view of evidence-based medicine.
2. The rational integrated approach was developed and experimentally substantiated using therapeutic exercises with resistance, elements of traction exposure in the water in combination with physiotherapeutic procedures, psychotherapy and therapeutic massage for 30-50-year-old men suffering from pains in the thoracic spine at the training stage of sanatorium treatment.
3. The high effectiveness of the developed and applied program of physical therapy in the examined contingent of patients compared to the generally accepted program used in sanatoriums was proved.

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The Authors declare no conflict of interest

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### **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*

# Injury Framework and Relevance of Physiotherapy of Upper Limbs` Injury and Pain Syndromes in Cadets of Higher Military Educational Institutions

## Zakres urazów i znaczenie fizjoterapii urazów i zespołów bólowych kończyny górnej u kadetów wojskowych szkół wyższych

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### SUMMARY

**Aim:** To justify the need of introduction of physiotherapy for the prevention and rehabilitation after injuries and pain syndromes of upper limbs in cadets.**Materials and Methods:** The research was conducted on the basis of the Hetman Petro Sahaidachnyi National Army Academy. At the first stage, data from the documents from the medical department on recorded injuries in the Academy cadets for the period 2018-2020 were analyzed. At the second stage, cadets of 1st, 2nd and 3rd courses of the Department of Combat Use of Forces were questioned about their experience of injuries and occurrence of pain syndromes. The total number of respondents equaled 256.**Results:** Analysis of medical data revealed that in 2018-2020 years there were 53 cases of injury in cadets. Fractures was on the top of the structure of registered injuries – 45% out of the total number of injuries; the cerebral injuries equaled 16% and bruises – 11%. Analysis of the experience of injury and occurrence of pain syndromes found that the most common were lower limbs` injuries (35% out of the total number of injuries indicated by the respondents), back injuries (25%) and upper limbs` injuries (15%) in cadets of all years of studying. According to the localization of injuries, they were distributed as follows: complaints of injuries in lower limbs were in 86 (35%) cadets; in the upper limbs – among 36 cadets (15%); back injuries was indicated by 62 (25%); the head injury – by 27 (11%), the neck injury – 17 (7%), the abdomen – 12 (5%), the chest injury was indicated by 6 (2%) respondents.**Conclusions:** The main part of complaints in cadets was occurrence of injuries and pain syndromes in lower and upper limbs, as well as in the back. Injuries of the upper limbs in cadets were a big problem throughout the training period, and in 16% of respondents, pain in the upper limbs was present for some period in recent month before the survey. The intensity of pain ranged from weak to severe.**Key words:** Shoulder, Military, Exercise Therapy, Chronic Disease, Overused injury**Słowa kluczowe:** bark, wojsko, terapia ruchowa, choroba przewlekła, urazy nadużywane

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### INTRODUCTION

Physical training, participation in sports and applied exercises in the framework of military training are an important and integral part of the training in cadets of higher military educational institution (HMEI) [1, 2]. Physical training of cadets of Ukraine HMEIs, provides theoretical component and practical training of specific skills and qualification of military service. These skills include defense tactics, gunnery drill, live throwing, as well as wearing a special gear, carrying military equipment, etc.

Lots of physical activities and a desire in cadets to improve their results may lead to injuries of the musculoskeletal system [3]. Acute injuries during training can be associated with the method of leading drills, the peculiarity of performing exercises, inappropriate material and technical support, behavior of cadets [4]. However, overuse injuries (accumulative and

chronic injuries due to overuse) occupy the first place in statistics of injuries in military during training and mainly arise in the period of increasing volume and intensity of physical training [5]. The study by Almeida SA et al. (1999) found that 36.9% of male recruits suffered musculoskeletal injuries during a 12-week boot camp training [5]. The main localizations of injury in recruits were lower limbs, back and upper limbs [6]. Although many injuries of the musculoskeletal system associated with physical activity can be prevented, in Ukraine there are no studies on the structure of injuries in cadets and their rehabilitation.

Development of effective preventive strategies and physiotherapy programs in case of injury requires understanding of injury prevalence, potential risk factors, and the need for cadets to recover.

## AIM

To justify the need of introduction of physiotherapy to prevent and rehabilitate cadets after injuries and pain syndromes of upper limbs.

## MATERIALS AND METHODS

The research was conducted on the basis of the Hetman Petro Sahaidachnyi National Army Academy (Academy).

At the first stage, data from the documents from the medical department of the Academy on recorded injuries in cadets (2018–2020) were analyzed.

At the second stage, a survey in men cadets of first, second, and third-years of studying from the Faculty of Combat Arms was organized. The total number of respondents was 256 people: 79 cadets of first year, 90 – of second and 87 – of third year of studying. The survey was conducted in live format using questionnaires to be completed in writing.

To retrospectively assess the level of injuries and occurrence of pain syndromes in cadets, a special questionnaire was developed. It included introductory information, data on the presence or absence of a conflict of interest and part about an informed consent. The first section of the questionnaire was devoted to identify the sociodemographic characteristics of cadets; the second – the presence of an experience of injury during training; the third – the occurrence of injuries in upper limbs.

The answers were analyzed quantitatively and qualitatively.

The volume of exercise load (VEL) was counted according to the formula:

$$VEL = \text{training duration (years)} * 52 * \text{number of trainings (hrs per week)}$$

If any respondent indicated only duration of training in a certain sport/physical activity in years without specifying the number of classes per week, the average value (3 hours per week) was used to calculate the VEL index. If the respondent specified the range of hours of training, a smaller value was used to count the VEL. If the respondents indicated only sport/physical activity, which they were performing before entering a military educational institution, without the duration of training in years, the VEL was not calculated.

The research protocol was approved by the Committee on Bioethics of Lviv State University of Physical Culture named after Ivan Boberskyj. Respondents were acquainted with the aim and objectives of the study, their rights; participants could refuse to participate at any stage of the study.

## RESULTS

Analysis of medical data revealed that during 2018–2020, 53 cases of injury were registered in cadets (Table 1). The centrepiece in them were fractures (45%), cerebral injuries (16%), and bruises (11%). Other injuries were isolated cases.

The injuries registered in 2018–2020 years in cadets were acute (arising from a sudden, severe, traumatic event), requiring organization of first aid and/or further delivery to the clinic [7]. Other injuries (chronic, associated with a repeated physical activity) were not registered by the medical unit.

To observe other experience of injuries and occurrence of pain syndromes, survey of cadets of 1st, 2nd and 3rd

**Table 1.** Numbers of cadets, who got injured in the period of 2018–2020, according to the Academy data

| Type of injury       | Number of injured n (%) |
|----------------------|-------------------------|
| Fracture             | 24 (45%)                |
| TBI                  | 9 (16%)                 |
| Bruises              | 6 (11%)                 |
| Burns                | 3 (6%)                  |
| Stab and slash wound | 2 (4%)                  |
| Concussion           | 2 (4%)                  |
| Polytrauma           | 2 (4%)                  |
| Traumatic amputation | 2 (4%)                  |
| Sprain               | 1 (2%)                  |
| Poisoning            | 1 (2%)                  |
| Ligament tear        | 1 (2%)                  |
| Total                | 53                      |

years of studying was conducted (Table 2). The average age of first year respondents was  $18.5 \pm 2.2$ , second year –  $19.3 \pm 1.76$  and third –  $21.1 \pm 2.8$ . An average body mass index was within the age norm,  $22.36 \pm 2,3 \text{ kg/m}^2$ .

The presence of unhealthy habits was indicated by 68% of respondents, from whom 58% mentioned tobacco smoking. Among other harmful habits, cadets of the first year indicated consumption of energy drinks, scratching the wounds, biting nails. The combination of tobacco smoking and alcohol consumption was indicated by 2 first-year cadets, 5 second-year cadets and 7 third-year cadets.

In 75% of cases, respondents had previous experience in performing sports: with a coach, in a sports team or club before entering the Academy. Only 25% of respondents did not have such experience.

Among the respondents, 141 (55%) indicated the occurrence of injury and/or pain syndrome during training (Table 3). The total number of injuries and pain syndromes mentioned by cadets was 246 cases, 93 (38%) of which were in cadets of the first, 58 (23%) – the second and 95 (39%) – the third year of studying. According to the localization of injury and pain syndromes, the complaints of injuries in lower limbs were in 86 (35%) cadets; 36 (15%) indicated having experience of injury in upper limbs, 62 (25%) – in back, 27 (11%) – in head, 17 (7%) in neck, 12 (5%) – in abdomen, 6 (2%) mentioned having experience of injury/pain syndromes in chest.

Out of 141 people with complaints of pain or injury, only 72 (51%) respondents consulted a doctor. For 55 (76.3%) of them, treatment was prescribed and in 51 (70.8%) of cases recommendations for self-management were given.

During training at the Academy, 15% of respondents had experience of injuries and pain syndromes in upper limbs, which, along with a significant amount of physical exertion, mainly using the upper limbs (in particular, pressing-out, pull-ups, grenade throwing, low crawling, competing in sports), prompted to analyze the intensity of pain that occurred in them (Table 4). It was observed that 41 (16% out of total number of respondents) cadets had pain in upper limbs during recent month; 20 people (49%) described it as moderate, 16 (39%) – as mild, 5 (12%) – as severe.

**Table 2.** Sociodemographic characteristics of cadets of high military educational institution

| Characteristics  | Cadets                    |                             |                             |                             |
|--|---------------------------|-----------------------------|-----------------------------|-----------------------------|
|  | Total<br>(n=256)<br>n (%) | 1st year<br>(n=79)<br>n (%) | 2nd year<br>(n=90)<br>n (%) | 3rd year<br>(n=87)<br>n (%) |
| Age, M±SD, years   | 19.73±2.53                | 18.57±2.2                   | 19.39±1.76                  | 21.16±2.8                   |
| Body height, M±SD, cm  | 179.32±6.62               | 180.3±6.71                  | 179.29±7.26                 | 178.42±5.73                 |
| Body mass, M±SD, kg  | 72.24±7.56                | 71.51±7.19                  | 72.65±8.71                  | 72.54±6.61                  |
| BMI, M±SD, kg/m <sup>2</sup>   | 22.36±2.3                 | 21.99±1.54                  | 22.56±2.03                  | 22.5±3.03                   |
| Marital status:  |                           |                             |                             |                             |
| – single   | 248 (97%)                 | 75 (95%)                    | 88 (98%)                    | 85 (98%)                    |
| – married  | 8 (3%)                    | 4 (5%)                      | 2 (2%)                      | 2 (2%)                      |
| Children:  |                           |                             |                             |                             |
| – yes (present)  | 4 (1%)                    | 0                           | 1 (1%)                      | 3 (4%)                      |
| – none   | 252 (99%)                 | 79 (100%)                   | 89 (99%)                    | 84 (96%)                    |
| Presence of unhealthy habits:  |                           |                             |                             |                             |
| – cadets, who indicated having such  | 162 (63%)                 | 45 (57%)                    | 57 (63%)                    | 60 (69%)                    |
| – smoking (tobacco, hookah, GLO)   | 148 (58%)                 | 42 (53%)                    | 52 (57%)                    | 54 (62%)                    |
| – alcohol consumption  | 26 (10%)                  | 2 (3%)                      | 11 (12%)                    | 13 (15%)                    |
| – other  | 3 (1%)                    | 3 (4%)                      | 0                           | 0                           |
| Military service experience before studying in the Academy:                        |                           |                             |                             |                             |
| – yes  | 51 (20%)                  | 14 (18%)                    | 15 (17%)                    | 22 (25%)                    |
| – no   | 205 (80%)                 | 65 (82%)                    | 75 (53%)                    | 65 (75%)                    |
| Performing sport (with a coach, in team, sports club) before entering the Academy: |                           |                             |                             |                             |
| – yes  | 192 (75%)                 | 67 (85%)                    | 66 (73%)                    | 59 (68%)                    |
| – no   | 61 (25%)                  | 9 (15%)                     | 24 (27%)                    | 28 (32%)                    |
| VEL, M±SD, hrs   | 1006.04±912.17            | 884.33±857.77               | 1132.11±1067.65             | 1003.02±756.47              |

Notes: M – the mean; SD – standard deviation; BMI – body mass index; GLO – tobacco heating system; Academy – high military educational institution, where the research was conducted; VEL – volume of exercise load

## DISCUSSION

This study is the first to quantitatively assess experience of injury and pain in cadets of the HMEI of Ukraine, the general structure of injuries and to qualitatively analyze the occurrence of pain syndromes in upper limbs. A retrospective cohort study was conducted on the basis of self-reported answers. The possibility of using the current research design and high accuracy of the data obtained in comparison with medical records is confirmed in the military members' cohort [8].

In 2018–2020, the medical unit of the Academy registered 53 acute injuries of cadets, among which 45% accounted for fractures of various anatomical areas. According to the data by foreign authors, proportion of acute injuries in cadets, recruits and military personnel during training and studying equals in range from 22% to 44% [3, 5]. Most traumas were overuse injuries, data on which in Ukrainian cadets were not available.

The sample of studied cadets was homogeneous both in demographic and social characteristics. Only 20% of respondents had experience of previous military service. However, 75% were engaged in various sports with the coach, club, team or section before admission to the Academy. An average volume of exercise load for the entire training period was 1006.04 ± 912.17 hours.

The general frequency (55% of cadets) and prevalence of injuries and pain syndromes by localization in anatomical areas in the study were similar to those described in other studies in military [8, 9]. A total of 141 cadets experienced at least one injury or pain syndrome during studying and reported 246 such cases. The highest level of injury is found in cadets of the first (60%) and third (61%) years of studying.

An analysis of localization structure of injuries and pain syndromes found that the most common in cadets of all studied years were lower limbs' injuries (35% of the total number of injuries indicated by the respondents), back injuries (25%) and upper limbs' injuries (15%). This coincides with study [9] on the severity and prevalence of injuries in anatomical areas, but the level of distribution of upper limb injuries in various studies depends on the specifics of professional activity. In particular, 12.4% of injuries to various anatomical areas of the upper limb were reported by military personnel occurring during their sports training; increasing of injuries to 16.7% occurred during sports activity in spare time [9]. At the same time, police officers who, according to physical training requirements, are similar to military personnel, reported significantly higher risks of shoulder (20%) or any area of the upper limb injury (39.4%) [10]. In addition, it was

**Table 3.** Clinical profile of cadets and their experience of injury and pain syndromes during training

| Characteristics   | Cadets                    |                           |                           |                           |
|---|---------------------------|---------------------------|---------------------------|---------------------------|
|   | Total<br>(n=256)<br>n (%) | 1 year<br>(n=79)<br>n (%) | 2 year<br>(n=90)<br>n (%) | 3 year<br>(n=87)<br>n (%) |
| Total number of cadets, who indicated experience of injury and/or pain syndrome(s)      | 141 (55%)                 | 48 (60%)                  | 40 (44%)                  | 53 (61%)                  |
| Total number of injuries and/or pain syndromes, indicated by cadets                     | 246                       | 93                        | 58                        | 95                        |
| Localization of injury or pain syndrome occurred during all studying period in Academy: |                           |                           |                           |                           |
| – lower limbs   | 86 (35%*)                 | 27 (29%*)                 | 23 (40%*)                 | 36 (38%*)                 |
| – upper limbs   | 36 (15%*)                 | 16 (17%*)                 | 7 (12%*)                  | 13 (14%*)                 |
| – back  | 62 (25%*)                 | 26 (28%*)                 | 15 (26%*)                 | 21 (22%*)                 |
| – head  | 27 (11%*)                 | 10 (11%*)                 | 4 (7%*)                   | 13 (14%*)                 |
| – neck  | 17 (7%*)                  | 6 (6%*)                   | 3 (5%*)                   | 8 (8%*)                   |
| – abdomen   | 12 (5%*)                  | 6 (6%*)                   | 4 (7%*)                   | 2 (2%*)                   |
| – chest   | 6 (2%*)                   | 2 (2%*)                   | 2 (3%*)                   | 2 (2%*)                   |
| Consulting doctor on the injury or pain syndrome occurred:                              |                           |                           |                           |                           |
| – yes   | 72 (51%**)                | 19 (39%**)                | 21 (52%**)                | 32 (60%**)                |
| – treatment prescribed  | 55 (39%**)                | 10 (21%**)                | 20 (50%**)                | 25 (47%**)                |
| – recommendations on further self-management  | 51 (36%**)                | 10 (21%**)                | 17 (42%**)                | 24 (45%**)                |

Notes: \* – the percentage was determined at the ratio of the total number of injuries and/or pain syndromes indicated by cadets; \*\* – the percentage was determined at the ratio of the total number of cadets, who indicated injuries and/or pain syndromes occurrence

**Table 4.** Pain intensity in cadets that occurred in upper limbs in the last month of studying year

| Pain intensity     | Cadets                    |                           |                           |                           |
|--------------------|---------------------------|---------------------------|---------------------------|---------------------------|
|                    | Total<br>(n=256)<br>n (%) | 1 year<br>(n=79)<br>n (%) | 2 year<br>(n=90)<br>n (%) | 3 year<br>(n=87)<br>n (%) |
| Number of suffered | 41 (16%)                  | 22 (28%)                  | 12 (13%)                  | 7 (8%)                    |
| Mild               | 16 (39%*)                 | 7 (32*)                   | 6 (50%*)                  | 3 (43%*)                  |
| Moderate           | 20 (49%*)                 | 14 (64*)                  | 3 (25%*)                  | 3 (43%*)                  |
| Severe             | 5 (12%*)                  | 1 (6*)                    | 3 (25%*)                  | 1 (14%*)                  |
| Intense            | -                         | -                         | -                         | -                         |
| Intorelable        | -                         | -                         | -                         | -                         |

Note: \* – the percentage was determined at the ratio of the total number of cadets, who mentioned occurrence of pain in upper limbs during recent month

found that longer periods out of service may be associated with injuries of upper limbs: shoulder joint (after  $26.1 \pm 28.3$  days), and hand (after  $17.0 \pm 29.3$  days) injuries [9], compared to indices of injuries of lower limbs (knee – after  $15.7 \pm 29.8$  days, ankle joint – after  $15.6 \pm 17.8$  days).

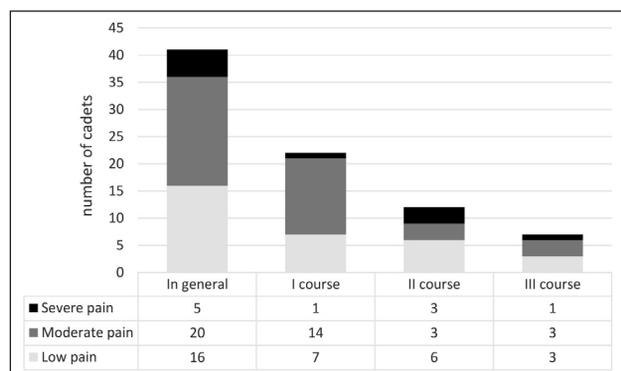
It should be noted that level of injury of lower limbs and back tends to increase in senior cadets, and the level of injury in upper limbs is maximum in cadets of the first year of studying. As for the injuries of other anatomical areas (head, neck, abdomen, chest), such tendencies are not followed.

It is important to note that this study revealed a low level of consulting a doctor in case of injuries or pain syndromes in cadets. On average, only 51% of the respondents consulted a doctor, 39% of them were cadets of the first year of studying, 52%

– of the second and 60% – of the third. The cause of this behavior in cadets was not clear, but it can have negative consequences on the course of injury, the quality of cadets` life and service, and contribute to the occurrence of complications.

A month before the survey, 16% of the respondents complained of pain in upper limb, including 39% of first-years, 13% – of second and 8% – of third-year cadets. The intensity of this pain in 49% of cases was mild, in 39% – moderate, and 12% – severe (Figure 1).

The results of our study confirm the hypothesis that cadets, during their studies at the HMEI, suffer not only acute injuries, but also chronic, cumulative injuries, in particular, of the upper limbs. The cause of such injuries is, oftenly, repeated micro-injuries, rather than isolated cases [11].



**Figure 1.** Distribution of pain intensity in upper limbs in cadets

Overuse injuries can be prevented, however, risk factors, prevention and treatment strategies` issues are not clarified yet [12]; although, the necessary component for prevention and rehabilitation after such injuries is physiotherapy.

Taking into account the prevalence and structure of injuries and pain syndromes of the upper limbs in cadets of HMEI, lack of proper information in cadets on the need of preventive measures, and risks of deterioration of the level of functioning in absence of proper physiotherapy, programs for prevention and rehabilitation are relevant.

## CONCLUSIONS

According to the documents of medicin department for 2018-2020, the main focus on treatment and rehabilitation covers only cadets with acute and severe injuries. Such injuries are registered and make up the basic statistics.

Other injuries (non-acute, chronic injuries and pain syndromes), the occurrence of which is indicated by 55% of respondents of the first, second, and third years of studying, are not registered. Out of 141 respondents, who indicated 246 injuries and pain syndromes in different body parts, only 51% consulted a doctor of the local medical unit concerning these complaints.

The main part of complaints was of injuries and pain syndromes in lower, upper limbs and back. Injuries of the upper limbs in cadets occurred throughout the training period, and in 16% of respondents, pain in the upper limbs was present at a certain period of recent month before the survey and was assessed from weak to severe of intensity.

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## Conflict of interest:

The Authors declare no conflict of interest

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# Analysis of Rehabilitation Inefficiency in Persons with Disabilities After Musculoskeletal Injuries

## Analiza nieskuteczności rehabilitacji u osób z niepełnosprawnościami po urazach układu mięśniowo-szkieletowego

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### SUMMARY

**Aim:** To analyze the reasons of low rehabilitation efficiency of persons with disabilities after musculoskeletal injuries.

**Materials and Methods:** A retrospective study of the 102 people's records whose permanent disability is extended after next certification was conducted.

**Results:** Only 31.4% persons reduced the severity of disability. The rest remained unchanged (67.6%) or deteriorated (1.0%). Permanent disability after musculoskeletal injuries is typical for men (86.3%), villagers (74.5%), working age (99.0%), of which 37.5% – men under 40 years. Near half persons (45.1%) have passed the next re-examination more than 3 times; in 52.0% ones four or more years have passed after injury; in 9.8% cases the continuation of rehabilitation is considered as hopeless. Defects in the implementation of rehabilitation measures were revealed, namely: excessive use of drugs with insufficient evidence of effectiveness (85.3-88.2%), inadequate coverage of physical therapy and occupational therapy (56.4%), a formal approach to the individual rehabilitation programs (IRP) formation, in particular in the assessment of rehabilitation potential (100.0%), the degree of movement restrictions (20.6%), social and labor rehabilitation (36.3%). Despite the fact that the majority of the observed people (86.3%) were recognized as capable for work, only 63.7% were provided with advice on rational employment, and 78.4% of them do not work.

**Conclusions:** Improving of the rehabilitation effectiveness requires comprehensive integrated solutions at the state level in order to change approaches to assessing the degree of disability, the formation and implementation of IRP based on modern world standards.

**Key words:** rehabilitation, disability, medical and social expertise

**Słowa kluczowe:** rehabilitacja, niepełnosprawność, doświadczenie medyczne i społeczne

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### INTRODUCTION

The state loses knowledge, skills and experience with each person who has acquired a disability and lost the ability to work to one degree or another [1]. Moreover, it is a serious economic challenge and financial burden for both the health care system and the country as a whole [2].

From year to year, injury is one of the priority causes of permanent disability [3]. Furthermore, according to the study Global burden of disease 2017 [4], musculoskeletal injuries are the second leading cause of disability in the world. This creates a significant need for rehabilitation services that cannot be met at present, especially in low- and middle-income countries. Lack of attention from the state to the problem and, as a result, low funding, poor coordination between agencies providing rehabilitation

services (in Ukraine, the Ministry of Health and the Ministry of Social Policy), and lack of rehabilitation specialists etc. are often hampered [5]. Therefore, the content of the rehabilitation process often differs significantly from the local practice realities [6]. After all, according to the current Ukrainian legislation, an individual rehabilitation programs (IRP) is developed for each person who receives the status of disability for the first time at the medical and social expert commission (MSEC). However, the majority (98%) of people with disabilities on re-examination remain unchanged [7], which indicates the ineffectiveness of rehabilitation measures and the need for detailed analysis of rehabilitation as a holistic process from the moment of injury to the moment of return to the fullest possible life and integration into society [8].

### AIM

Analyze the reasons of the low rehabilitation efficiency of persons with disabilities after musculoskeletal injuries and identify areas for improvement.

### MATERIALS AND METHODS

A retrospective medical and social study of medical records of the Ivano-Frankivsk Regional Bureau of Medical and Social Expertise for 2019 was conducted.

Information from 102 medical records of persons with disabilities after musculoskeletal injuries, who passed the next examination and whose extended term of permanent disability was extended, was processed and copied. The age and gender distribution, frequency of examination, duration of disability, changes in the degree of disability (disability group), frequency of medical interventions and rehabilitation measures applied at the time of the initial and last MSEC examination, the content of IRP were analyzed.

Statistical processing of the obtained material was performed by calculating the frequency of studied traits per 100 population and error ( $\pm m$ ) for proportions, and estimating the reliability of data differences in different observation groups and testing the null hypothesis was performed by calculating Chi-square ( $\chi^2$ ) [9].

The Ethics Commission of Ivano-Frankivsk National Medical University (Protocol № 101/18 of April 12, 2018) approved the research methods.

### RESULTS

It was found that the most common causes of permanent disability in the examinations were lower extremities fractures ( $47.1 \pm 4.0\%$ ). Next in severity were: spinal injuries ( $16.7 \pm 3.7\%$ ) and equally traumatic amputations of body parts ( $14.7 \pm 3.5\%$ ) and fractures of the upper extremities ( $14.7 \pm 3.5\%$ ). Significantly less often the cause of disability were multiple fractures ( $5.9 \pm 2.3\%$ ) and burns (one examined  $1.0 \pm 1.0\%$ ).

It was display that the majority of people with prolonged disability due to the musculoskeletal system injuries are men ( $86.3\%$  vs.  $13.7\%$  of women), as well as residents of rural settlements ( $74.5\%$  vs.  $25.5\%$  of urban residents).

Almost all observed people ( $99.0\%$ ) were in working age (Figure 1). Of them, a third of them ( $32.4\%$ ) – under the age of 40, the same proportion ( $32.4\%$ ) – persons aged 40-49 years and  $34.3\%$  – 50-59 years. Only one person over the age of 60 was included in the sample – a man, a resident of the city, with the third group of disability after fractures of the lower extremities, which was appointed for the 4th time.

There were no women among those re-recognized as disabled under the age of 40 – only men ( $p < 0.05$ ). All observed women were 40-49 years old ( $57.1\%$ ) and 50-59 years old ( $42.9\%$ ).

The majority of examined persons ( $78.4\%$ ) did not work. The part of unemployed among men is higher than among women –  $81.2\%$  vs.  $57.1\%$  ( $p < 0.05$ ).

During the first examination (Figure 2) only three people were diagnosed with the most severe first group of disability ( $2.9\%$ ), the second -  $40\%$  ( $39.2\%$ ) and the lightest third – almost  $60\%$  ( $57.8\%$ ) of the observed people.

At first glance, there was some positive dynamics at the time of the last examination, as in every third case ( $31.4\%$ ) the disability group improved and, accordingly, the part of people with the second (up to  $9.8\%$ ) and the first disability groups (up to one person) decreased, but increased with the third (to  $89.2\%$ ,  $p < 0.05$ ). However, the lack of effectiveness of rehabilitation programs is indicated by the fact that in two thirds of cases ( $67.6\%$ ) the severity of permanent disability remained unchanged and in one case – worsened.

This was confirmed by the results of a study on the duration of disability at the time of the last examination. Half of the observed people ( $52.0\%$ ) have had four or more years since the injury, which caused permanent disability, including  $12.7\%$  – more than 10 years. As it can be seen in Figure 3, among young people (up to 30 years old) these indicators were already quite significant and amounted to  $25.0\%$  and  $8.3\%$ , respectively. Among the observed people of 30-39 years, their levels more than doubled – to  $52.4\%$  and  $19.0\%$  ( $p < 0.001$ ). In the following age groups, the part of people with permanent disability (4 years or more) increased slightly ( $54.6\%$  among 40-49-year-olds and  $60.0\%$  – among 50-year-olds and older), and those

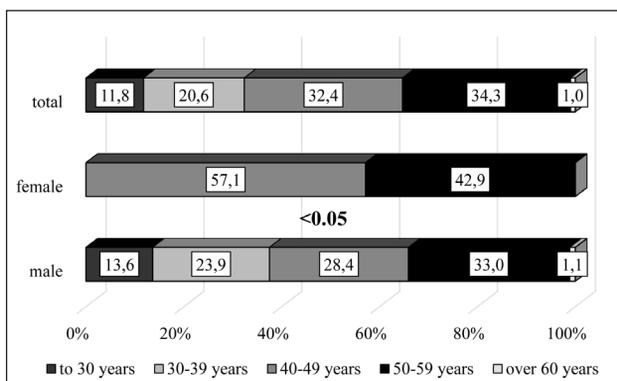


Figure 1. The age structure of the observed people

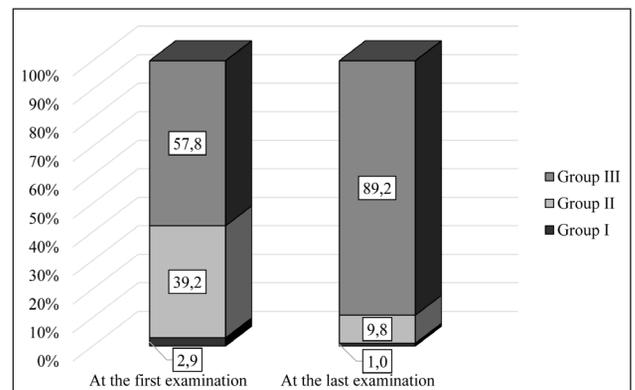
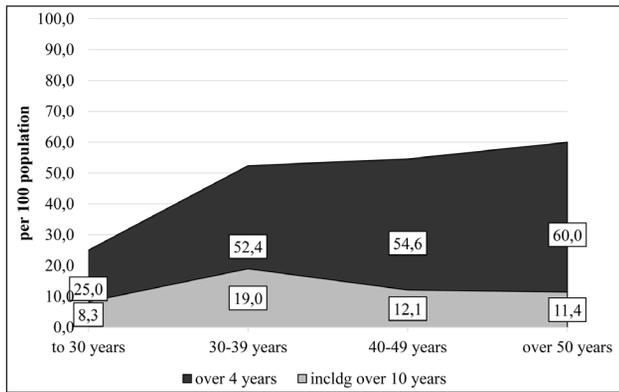


Figure 2. Disability group at the time of the first and last examination



**Figure 3.** Proportion of observed people with permanent disability depending on age

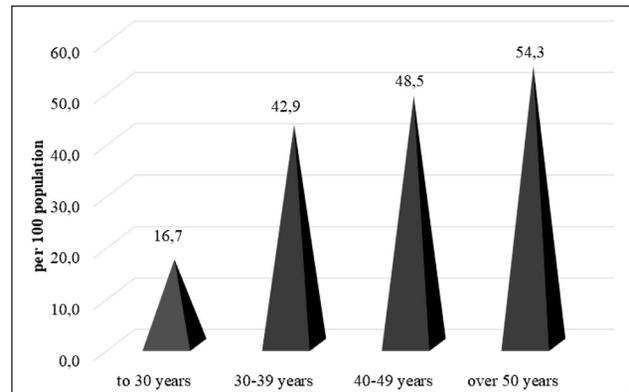
with more than 10 years – even decreased slightly (to 12.1% and 11.4% respectively).

Another confirmation of this hypothesis is that of all persons whose disability was extended, only in a third (35.3%) – there was the second in line re-certification. The rest underwent a similar procedure for the third (19.6%) time, and multiple (4 or more times) prolongation of permanent disability at MSEC in 45.1% of persons was observed. Moreover, there were already 16.7% of people under 30 (Figure 4), more than 40% (42.9%) aged 30-39 years, half aged 40-49 years (48.5%) and more than a half (54.3%) in 50-year-olds and older ( $p < 0.001$ ).

This high frequency of re-examinations is partly explained by the fact that the disability group is usually assigned (continued) depending on the rehabilitation potential and the patient's condition for a year or two, less often – for three years. In cases when the degree of restoration of lost functions has reached the maximum possible level, or after reaching retirement age, the status of a person with a disability is granted indefinitely. In our research, the duration of permanent disability was extended by 36.3% of observed people for one year, 38.2% for two years and 15.7% for three years. However, a tenth of those cases (9.8%) continued their disability group indefinitely, including in half of the cases they were people aged 40-49.

It was established that the set of medical and rehabilitation measures before the first and before the current re-examination differed significantly. It is clear that before the initial establishment of the fact of disability, the most common method of choice was surgical treatment (82.4% vs. 8.8% before the last re-examination,  $p < 0.001$ ).

Almost all observed people, both primary (99.0%) and repeated (99.7%,  $p > 0.05$ ), were prescribed drug therapy. At the same time, against the background of a logical decrease in the proportion of those who received specific treatment (nonsteroidal anti-inflammatory drugs from 64.7% to 46.1%, antibiotics from 57.8% to 9.8%), the specific weight of those who were prescribed drugs with insufficient evidence of effectiveness (dietary supplements, vitamins, chondroprotectors etc.) remained consistently high (85.3-88, 2%).



**Figure 4.** Percentage of observed people with multiple (4 times or more) confirmation of permanent disability depending on age

In parallel with the duration of permanent disability, the proportion of observed people covered by physical therapy and occupational therapy (from 16.1% to 56.4%,  $p < 0.05$ ) and non-drug treatment increased (from 1.8% to 11.3%,  $p < 0, 05$ ).

The analysis of the adjusted IRP based on the results of the re-certification at the MSEC indicates a formal approach to their preparation. Thus, not everyone has assessed the degree of restriction to self-care and movement. Of the total number of cases, it was recognized that one person (with the first group) was unable to move independently and is completely dependent on others. Another 11.8% of rehabilitators (which is more than the percentage of people with the second group) needed the use of aids or assistance from others. MSEC experts found that the vast majority of observed people (84.3%) had the ability to self-care with the use of aids, two-thirds of people with disabilities (66.7%) are able to move independently, although this requires more time and reducing the distance. However, in 2.9% of cases there is no degree of restriction of self-service, and in one of five (20.6%) – for the movement.

In all of the observed people the degree of labor activity restriction was assessed: one person was recognized incapable of working at all, another 12.7% could work in specially created conditions with the use of aids or a specially equipped workplace; most of the re-certified ( $86.3 \pm 3.4\%$ ) had the ability to perform work in another specialty or under conditions of reduced production activities.

MSEC experts assessed the rehabilitation potential of all 100% of people with disabilities after musculoskeletal injuries, regardless of the group, as medium.

For almost all persons with disabilities after musculoskeletal injuries were recommended medical rehabilitation measures, namely rehabilitation therapy ( $99.0 \pm 1.0\%$ ), further medical supervision ( $96.1 \pm 1.9\%$ ) and sanatorium treatment ( $95.1 \pm 2.1\%$ ), less often experts saw the need for reconstructive surgery ( $2.0 \pm 1.4\%$ ).

None of the examinees was given recommendations on psychological rehabilitation. Only one person was recommended physical rehabilitation – therapeutic exercise and therapeutic massage.

Most of the observed people were given recommendations for further employment. More than two thirds of disabled persons ( $64.7 \pm 4.7\%$ ) were recommended rational employment, a slightly smaller number ( $63.7 \pm 4.8\%$ ) – were given advice on occupations and specialties available for health reasons in each sixth case ( $14.7 \pm 3.5\%$ ) experts recommended adapting or creating a workplace for a person with a disability.

MSEC experts also recommended technical tools of rehabilitation for some of the rehabilitators. For almost half of them ( $41.2 \pm 4.9\%$ ) sticks became the means of choice, for another third ( $35.3 \pm 4.7\%$ ) – crutches, less often – orthopedic products ( $6.9 \pm 2.5\%$ ), auxiliary household appliances ( $2.9 \pm 1.7\%$ ) and wheelchairs of various types ( $1.0 \pm 1.0\%$ )

The main purpose of rehabilitation was most often to return to professional and labor activity ( $94.1 \pm 2.3\%$ ), in sporadic cases – the restoration of life limitations ( $4.9 \pm 2.1\%$ ) and social status ( $1.0 \pm 1.0\%$ ).

## DISCUSSION

In our research, it was found that one third (31.4%) of persons whose permanent disability was extended after the next examination at the MSEC, the disability group was alleviated. Considering that the positive dynamics are usually characteristic of patients with less trauma and higher rehabilitation potential [10], and that in 67.6% of observed people the severity of permanent disability remained unchanged, and in one case – worsened, we hypothesized ineffectiveness of rehabilitation measures in two thirds of persons with disabilities after musculoskeletal injuries. Moreover, the percentage of people diagnosed with disability indefinitely (9.8%) was quite high, half of whom were 40-49 years old. That is, the reason for this was not the achievement of retirement age (possible in the age group of 50-59 years), but the futility of continuing rehabilitation measures [11].

Our research showed that the most common causes of permanent disability were lower extremity injuries (47.1%), spinal injuries (16.7%), traumatic amputations of body parts (14.7%) and upper extremities fractures (14.7%).

The study also found that men (86.3%) were significantly more likely to have disabling musculoskeletal injuries. Researchers explain this by the fact that it is usually men who are engaged in hard physical work and work with the threat of injury, as well as lead a lifestyle associated with various challenges and risks - more often drink alcohol, get into accidents, participate in military conflicts etc. [12].

The results of the research showed that it is more often confirmed the disability of villagers (74.5%). It was found that most of the re-examined received the third group of disability (89.2%), which provides employment opportunities, 86.3% were recognized by MSEC experts as able to work, but did not work – 78.4% of cases (81,2% among men). That is, it can be assumed that the difficult socio-economic circumstances in the area of residence of a person with disabilities [11] were taken into account when deciding

MSEC to extend the period of permanent disability, as in rural areas it is usually difficult to find a job, especially the one that meets the capabilities of a person with a disability after an injury. In our viewpoint, this requires the adoption of appropriate management decisions at the state level. It is known that work for a person with a disability not only allows them to improve their financial situation, but is a condition of independence, forms and strengthens self-esteem, is a manifestation of social integration, helping to feel their own needs from family and society and serves an important form of rehabilitation [13, 14].

It is represented that almost all observed people (99.0%) were in working age, which on the one hand, meet the peculiarities of Ukrainian legislation on this issue (after 60 years comes the retirement age) [11], on the other – emphasize the medical and social importance of the problem. After all, a third of examined cases (32.4%) are under the age of 40.

The longevity of permanent disability was established in a significant proportion of observed people (52.0% passed four or more years after the injury that caused permanent disability, including 12.7% – more than 10 years) and a high frequency of re-recognizing (45.1% have undergone another re-examination for the 4th time or more) can be explained both by the objective impossibility to restore lost functions and the ineffectiveness of rehabilitation measures [6].

Analyzing the content of medical and rehabilitation services received by the observed people, it was found that their volume after the first establishment of the group and before the current re-examination changed significantly in the direction of logical reduction of surgical interventions (from 82.4% to 8.8%). At the same time, the coverage of physical therapy and occupational therapy increased from 16.1% to 56.4%, as well as non-drug treatments (from 1.8% to 11.3%). However, the levels of coverage of these methods of rehabilitation, in our opinion, are insufficient. After all, according to numerous scientific studies, important conditions for the success of the rehabilitation process are its early onset [15] and the use of a set of well-chosen physiotherapy techniques [16].

In addition, both before the first and before the current examination there was drug therapy (99.0% and 99.7%). Quite often, especially at the initial screening, patients were prescribed nonsteroidal anti-inflammatory drugs (64.7%) and antibiotics (57.8%), which, according to scientists, are not always justified [17]. It is alarming that the majority of observed people (85.3-88.2%) were constantly prescribed drugs with insufficient evidence of effectiveness (dietary supplements, vitamins, chondroprotectors, etc.).

The next assignment of the research was to assess the content of IRP, which according to the Law of Ukraine “On Rehabilitation of Persons with Disabilities” [11] should cover all areas of persons with disabilities’ life and include recommendations for medical, psychological, pedagogical, physical, professional, labor, social and household rehabilitation. However, the results of the study showed

a rather formal approach to the formation of IRP, in particular in the assessment of rehabilitation potential (in all 100.0% of cases, regardless of group, considered as medium), the degree of movement restriction (20.6% not defined), recommendations from social and labor (36.3% did not receive) and psychological (0%) rehabilitation. At the same time, researchers admit that not only diseases associated with illness or injury, but primarily social, institutional and psychological barriers stand in the way of the active integration of people with disabilities into society, successful socialization and performing important functions [18]. That is, it is time to reorient from the “medical” to the “social” approach to solving the problem of ensuring the effectiveness of rehabilitation measures [19].

## CONCLUSIONS

According to a retrospective analysis of medical records of persons with permanent disability was extended after the next examination at the MSEC, it was found that only 31.4% of them reduced the severity (group) of disability as a result of rehabilitation. The rest remained unchanged (67.6%) or deteriorated (1.0%).

It was brought to light that permanent disability due to musculoskeletal injuries is typical for men (86.3%), villagers (74.5%), working age (99.0%), of which 32.4% - up to 40 years. Most common causes of that are lower extremities fractures (47.1%), spinal injuries (16.7%), traumatic amputations of body parts (14.7%) and fractures of the upper extremities (14.7%).

It is shown that 45.1% have passed the next re-examination more than 3 times; in 52.0% four or more years have passed since the injury that caused permanent disability, including 12.7% – more than 10 years; in 9.8% of cases, half of whom are aged 40-49, the continuation of rehabilitation is considered hopeless.

Defects in the implementation of rehabilitation measures were identified, namely: excessive use of drugs with insufficient evidence of effectiveness (85.3-88.2%), inadequate coverage of physical therapy and occupational therapy (56.4%), a formal approach to the formation of IRP, in particular in the assessment of rehabilitation potential (100.0%), the degree of movement restriction (20.6%), social and labor rehabilitation (36.3%). Despite the fact that the majority of the observed people 86.3% were recognized as able for work, only 63.7% were provided with advice on rational employment, 78.4% of them do not work.

Improving the effectiveness of rehabilitation requires comprehensive integrated solutions at the state level to change approaches to assessing the degree of disability, the formation and implementation of IRP based on modern world standards.

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Info

**INFORMATION FOR DOCTORS**



**Viofor** – The first, non-pharmacological medical device with a clinically proven immunocorrective action. The topic which served as the inspiration to perform the clinical assessment in the field of improving the immune system was the appeal of the European Commission (2020) to intensify the search for direct or indirect treatment methods for patients suffering from COVID-19.

The therapeutic factor is the low-frequency and low-induction pulsed magnetic field, shaped as signals forming a multi-peak frequency spectrum in the Viofor JPS System.

Mechanism of action. The immuno-corrective effect occurs by stimulating the thymus-dependent maturation process of regulatory T cells and supplementing deficiencies of this cell population in the immune system, as well as by lowering the concentration of pro-inflammatory factors (interleukin 1beta, IL-1 $\beta$ ) and increasing anti-inflammatory factors (interleukin 10, IL-10), improving defensive performance of the immune system.

Immunological tests included the following parameters: proinflammatory cytokine concentration, anti-inflammatory and immunoregulatory cytokine concentration, immunological competence parameters of T lymphocytes (number and activity level of regulatory T lymphocytes), immunogenic activity of monocytes and selected cytokines, level of melatonin after surgery.

**Viofor** is the first medical device with effect immunocorrective effect and a non-pharmacological method of improving the immunity. Viofor's magnetic field of low frequency stimulates the thymus-dependent maturation process of T lymphocytes, decreases the concentration of pro-inflammatory factors (interleukin 1beta, IL-1 $\beta$ ) and increases the anti-inflammatory factors (interleukin 10, IL-10) improving the defensive efficiency of the immune system.

An important confirmation of the immunocorrective mechanism of Viofor JPS magnetostimulation is the immunotropic interaction not only “in vivo” in relation to the whole organism, but also “in vitro” in relation to immune cells isolated from blood. Viofor's Magnetic field of magnetostimulation exerts an immunocorrective effect by improving the defensive functions of the immune system thus supporting the functioning of the immune system.

Based on the obtained results, it was found that the magnetic field stimulation of the Viofor JPS System improves thymus-dependent maturation process of regulatory T cells and supplements deficiencies of the cell population in the immune system, as well as by reducing the concentration of proinflammatory factors (interleukin 1beta, IL-1 $\beta$ ) and an increase in anti-inflammatory factors (interleukin 10, IL-10), improving the defensive efficiency of the immune system.

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# Characteristics of the Medical Nutrition of the Polytraumatized Patients in Presence of Obesity

## Charakterystyka żywienia leczniczego u otyłych pacjentów po urazie wielonarządowym

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### SUMMARY

**Aim:** To determine the characteristics of the Medical Nutrition of the Polytraumatized Patients in presence of obesity.**Materials and Methods:** The clinical material is represented by 42 polytraumatized patients hospitalized at the Department of Surgery of the Municipal Non-Profit Organization "8th Municipal Clinical Hospital of Lviv".**Results:** The posttraumatic catabolic condition requires the energy balance with the early substitution of protein and hypercaloric nutrition. The patients with obesity in the presence of massive severe injuries not receiving the necessary nutrition within the first days after the trauma may develop the cumulative deficit of calories and proteins that conditions the development of the severest complications related to the repeated infecting, and, consequently, the multiple organ dysfunction. The early enteral nutrition for the injured patients with obesity demonstrated a convincing positive result in the form of the prevention of infectious diseases and, correspondingly, improved the results and period of treatment.**Conclusions:** The patients with obesity in the presence of massive severe injuries not receiving the necessary nutrition within the first days after the trauma may develop the cumulative deficit of calories and proteins that conditions the development of the severest complications related to the repeated infecting, and, consequently, the multiple organ dysfunction,**Key words:** obesity, polytrauma, medical nutrition**Słowa kluczowe:** otyłość, uraz wielonarządowy, żywienie medyczne

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### INTRODUCTION

The issue of polytrauma is a subject of many publications in the world literature, as well as the diagnostics and treatment of polytraumatized patients remains one of the topical issues not only of Emergency Surgery but also of many allied medical specialties. It has already been mentioned that the concomitant injuries and multiple bodily injuries cause the development of the traumatic disease, the fatality rate of which ranges from 10.7% to 69.7%, depending upon the severity of injuries [1, 2]. However, these data mostly concern people with normal body weight. Speaking of the obesity that actually becomes the world pandemic, it creates an additional financial burden for the healthcare system around the world. Judging by the USA data, the annual expenses related to the diseases caused by obesity, exceed those of the patients with the normal body weight by about 1500 USD [3]. Besides, obesity is one of the factors increasing the risk of traumas both in everyday life

and at the workplace, and the concomitant injuries caused by the traffic accidents occupy one of the leading positions in the overall structure of the modern polytraumas of this category of patients that cumulatively causes the substantial challenges in the sphere of medicine [4, 5]. To our point of view, the increased risk of polytraumas for people with obesity can be caused by multiple factors. Such people, due to the overweight, cannot promptly respond to the danger or avoid it, eliminate the traumatizing factors or provide adequate self-aid.

To our point of view, the belief that a substantial layer of fat of obese people protects them during the trauma due to the better amortization feature of the fat tissue is absolutely erroneous.

Besides, B.H. Waibel provides the results of his studies that are very much to the point where he states that in case of the closed abdominal trauma of the patients with obesity,

the subcutaneous tissue has no essential protective effect and the fatty liver infiltration rather causes even more severe ruptures and the higher the BMI, the higher the rupture level [6]. Concerning the level of the spleen rupture, the substantial correlation with the obesity level has also been observed, however, this phenomenon has not been explained from the pathomorphological point of view.

Considering the above, the patients suffering from obesity occupy a special position in the totality of the polytraumatized patients. Actually, each fifth injured hospitalized patient is with a  $BMI \geq 30 \text{ kg/m}^2$  that corresponds to class II obesity [7]. Among the factors aggravating the condition of such patients is the injury of the chest organs, abdominal cavity, and large retroperitoneal hematomas. However, despite the substantial incidence (frequency of the diseases) of traumas, the diagnostic and treatment approaches to polytraumas of people with obesity, except for the specialized injury surgery departments, do not practically differ from the general bases of diagnostics and treatment of the surgical diseases applied to the patients with the normal body weight [8]. Noteworthy that the injuries of the polytraumatized patients in presence of obesity were much severe as compared to the people with normal body weight that is confirmed by the metabolic system disorders, morphological symptoms of dysfunctions, and growing connective tissue with the further stroma – vascular dystrophy [9].

### AIM

To determine the characteristics of the medical nutrition of the polytraumatized patients in presence of obesity.

### MATERIALS AND METHODS

The clinical material is represented by 42 polytraumatized patients hospitalized at the Department of Surgery of the Municipal Non-Profit Organization "8th Municipal Clinical Hospital of Lviv". Out of them, 23 (54.8%) patients had concomitant blunt trauma of the chest, blunt trauma of the abdomen, and closed craniocerebral injury. The pelvic or limbs fractures were observed in 19 (45.2%) patients. The age of the patients ranged within 18 - 87 (average age:  $43.6 \pm 1.3$  yrs.), men: 28 (66.7%), women: 14 (33.3%), working-age persons: 34 (80.9%).

Depending upon the BMI, all patients were subdivided into three clinical groups. The first group included 14 patients with a normal body weight ( $BMI \geq 24.9 \text{ kg/m}^2$ ), the second one included 17 patients with overweight and class I obesity ( $BMI = 26.2\text{-}34.2 \text{ kg/m}^2$ ) and the third one: 11 injured patients with class II-III obesity ( $BMI = 35.3\text{-}41.9 \text{ kg/m}^2$ ).

### RESULTS

The amount of medical aid to the injured patients at the pre-hospitalization stage depended upon the subjective assessment of the patient's general condition by the emergency teams. Initially, the severity condition was assessed, the presence of the well-functioning fluid-administration sets, the quality of immobilization of the injured segments, and the conditions and time of injuries were clarified. Correspondingly, the condition of 19 (45.2%) patients was determined as moderately

severe, 15 (35.7%) – as severe, and 8 (19.1%) – as extremely severe. Besides, 34 (80.9%) patients were verbally accessible that allowed to gather the medical history and 8 (19.1) were in the altered state of consciousness. Out of 19 patients, 9 (47.4%) belonged to the I clinical group, 10 (52.6%) – to the II clinical group. The overweight patients and patients with obesity were the most problematic in this group of patients since practically every second patient (4 persons) was diagnosed with the mistakes, mainly, the fractures of one and more ribs (2 persons) aggravated by the hemopneumothorax, non-diagnosed intra-abdominal hemorrhage (3 persons) 2 more patients have not been timely diagnosed the verified multiple pelvic fractures and femur bone fractures.

Out of the patients in the serious condition 7 patients (46.7%) belonged to the II clinical group and the other 8 patients (53.3%) to the III clinical group. The typical mistakes for this group of patients were as follows: non-verified fractures of the rib cage aggravated by the hemopneumothorax in all injured patients with class II-III obesity, intra-abdominal hemorrhage in 6 patients (40.0%), and pelvic or limbs fractures in 4 patients of the II clinical group. No respiratory support during the closed chest injury in 10 (23.8%) patients as of the moment of hospitalization caused the development of the long-time hypoxia that was hard to manage at the stage of hospitalization which conditioned the durable application of the artificial lung ventilation apparatus and prolonged the period of stay at the intensive care unit by  $4.7 \pm 1.3$  days ( $> 0.03$ ) on average.

On the other hand, noteworthy that in case of the inadequate assessment of the severity of the patient's condition the inappropriate antishock therapy was administered. It is commonly known that the femur fracture causes a blood loss of more than 500ml, pelvic fracture: about 2,000 ml, and concomitant injuries: 3,000 ml that is about 90% of the blood volume (BV) [10]. In case of blunt trauma of the abdomen with the injury of the parenchymal organs of the abdominal cavity (liver, spleen) the blood loss may range between 500-3,000 ml. [11]. Thus, for 6 (14.3%) patients with undiagnosed skeleton fractures, no transport immobilization was provided that could cause the additional injuries with the bone fragments. For 13 (31.0%) patients with the confirmed limb fractures, the splinting was carried out using the standard and impromptu means, however, for 5 of them, no immobilization was provided of at least two joints adjacent to the place of injury that resulted in an unstable fixation. The BV was replenished with the isotonic and hypertonic colloid and crystalloid solutions calculated as not less than 20ml of infusion solution per 1 kg of body weight of the patient depending upon the type of injury and severity of the patient's condition. Correspondingly, the stable hemodynamic parameters as of the moment of the patient inspection and non-verified injuries in 22 (52.4%;  $p > 0.04$ ) constituted the reason for the denial of the adequate antishock therapy at the pre-hospitalization stage, mainly, the narcotic pain medication at the skeleton injury of 15 (35.7%;  $p > 0.05$ ) patients have not been injected, the BV has not been adequately replenished at the pelvic fractures, femoral fractures, and intra-abdominal hemorrhage of 12

(28.6%;  $p > 0.05$ ) patients that consequently substantially aggravated the condition of the injured (considering the presence of different classes of obesity of the patients before the hospitalization).

Out of the patients in the serious condition, 5 (62.5%) were with the normal body weight, 3 (37.5 %) with class II obesity. For the last sub-group of the patients, the emergency team applied all available means of emergency management at polytrauma according to the common standards.

All patients after the hospitalization were immediately examined by the Surgeon, Emergency Physician, Neurosurgeon, and Traumatologist. In 87.5% of cases, the Cardiologist or General Practitioner were involved. After the receipt of the initial data of the physical examination, the Surgeon determined the list and sequence of the additional examination methods.

To assess the informative value of the traditional examination methods at the hospitalization stage, the sensitivity and specificity of the diagnostic tests were assessed. The objective examination of the thoracic organs (palpation ( $s=72.4\%$ ,  $f=95.9\%$ ), percussion ( $s=76.1\%$ ,  $f=97.1\%$ ), auscultation ( $s=79.1\%$ ,  $f=96.8\%$ )) of the patients of I clinical group allowed determining the precise diagnosis of practically all the patients (95.0%).

Besides, for the patients with obesity the value of these examinations was reduced. Thus, in the II clinical group the preciseness of the methods was as follows: palpation ( $s=66.4\%$ ,  $f=87.9\%$ ,  $p>0.05$ ), percussion ( $s=71.4\%$ ,  $f=91.4\%$ ,  $p>0.05$ ), auscultation ( $s=75.1\%$ ,  $f=90.1\%$ ,  $p>0.04$ ), and for the III group it was substantially reduced: palpation ( $s=61.4\%$ ,  $f=75.9\%$ ,  $p>0.05$ ), percussion ( $s=67.2\%$ ,  $f=62.1\%$ ,  $p>0.05$ ), auscultation ( $s=64.4\%$ ,  $f=77.5\%$ ,  $p>0.03$ ), that necessitated the pleural puncture for the injuries diagnostics.

For the diagnostics of the organs of abdominal cavity for the patients of the I clinical group, the objective examination methods were enough, the sensitivity and specificity of which for the people with the normal body weight is high: (palpation ( $s=73.6\%$ ,  $f=96.1\%$ ), percussion ( $s=77.2\%$ ,  $f=96.9\%$ ), auscultation ( $s=82.3\%$ ,  $f=97.7\%$ )), which is confirmed by the U/S examination results which showed the free liquid in the abdominal cavity ( $s=82.7\%$ ,  $f=98.9\%$ ). All patients got operated, the laparotomy was carried out, the hemorrhage was arrested with the elimination of injuries and drainage of the abdominal cavity.

For the patients of II clinical group, the diagnostic value of the objective methods was reduced (palpation ( $s=71.6\%$ ,  $f=90.2\%$ ,  $p>0.05$ ), percussion ( $s=75.2\%$ ,  $f=94.1\%$ ,  $p>0.04$ ), auscultation ( $s=80.1\%$ ,  $f=91.2\%$ ,  $p>0.05$ )), however, the meaning of U/S remained high enough ( $s=80.6\%$ ,  $f=4.1\%$ ,  $p>0.05$ ), that permits diagnosing the injuries without the invasive tests.

However, for the patients of III clinical group the sharp reduction of the diagnostic adequacy of the palpatory examination was observed ( $s=64.7\%$ ,  $f=79.1\%$ ,  $p>0.05$ ), percussion ( $s=66.8\%$ ,  $f=84.4\%$ ,  $p>0.05$ ), and auscultation ( $s=62.4\%$ ,  $f=62.1\%$ ,  $p>0.03$ ), besides, the sensitivity and specificity of U/S also reduced and amounted to  $s=70.9$  and  $f=81.4\%$  ( $p>0.03$ ) correspondingly. Thus, the absence of the clear diagnostic criteria created the grounds for the abdominal

paracentesis of all patients in presence of obesity that finally allowed diagnosing the intra-abdominal hemorrhage. These patients got operated, the laparotomy was carried out, the hemorrhage was arrested with the elimination of injuries and drainage of the abdominal cavity.

## DISCUSSION

The progression of the traumatic disease of people with obesity is characterized by the low level of compensation ability of the body connected with the presence of multiple chronic diseases of cardiovascular, pulmonary system, locomotor system, and functional disorders of the organism that substantially reduces the possibility of the positive result in treatment of this group of patients [12].

The matter is that the severe concomitant trauma causes substantial changes of the physiological condition through the change of the metabolic pathways and activation of the inborn immune system, especially for the patients suffering from obesity and overweight [13, 14]. The post-traumatic metabolic changes depend upon the level of obesity and are characterized by hypermetabolism with the increased energy consumption, intensified catabolism of proteins, insulin resistance connected with the hyperglycemia, inability to tolerate the glucose loading and high level of insulin in plasma, the so-called "traumatic diabetes" [2, 8]. The changes of the physiological metabolic pathways result in the development of hyperglycemia and metabolic acidosis at hyperlactatemia [9]. If the increased need for oxygen is not met, the hypermetabolic state of the patients substantially aggravates due to the intensified consumption of mitochondrial oxygen [1, 13].

The posttraumatic catabolic condition requires the energy balance with the early substitution of protein and hypercaloric nutrition [4, 11]. The patients with obesity in the presence of massive severe injuries not receiving the necessary nutrition within the first days after the trauma may develop the cumulative deficit of calories and proteins that conditions the development of the severest complications related to the repeated infecting, and, consequently, the multiple organ dysfunction. In other words, it should be kept in mind that the organism of the person with obesity which is used to consuming much food, at polytrauma is very much stressed due to the lack of the necessary energy, vitamins, microelements that causes the development, among other things, of the post-traumatic catabolic condition. Now, it has to be said that we agree to the conception of the early enteral nutrition for the patients with obesity that demonstrated the positive effect preventing the infectious complications and, correspondingly, improved the results and period of treatment [9, 12]

## CONCLUSIONS

The patients with obesity in the presence of massive severe injuries not receiving the necessary nutrition within the first days after the trauma may develop the cumulative deficit of calories and proteins that conditions the development of the severest complications related to the repeated infecting, and, consequently, the multiple organ dysfunction. Such patients need the special approach with the substantial analysis of the

provisions concerning the studying of the diagnostic value of the clinical, instrumental, and special examination methods, elaboration of the program of differential complex treatment of patients with obesity considering the peculiarities of the traumatic disease and condition of the macroorganism where the obesity is a severe aggravating factor as well.

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Info



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# Interdisciplinary Team – is there a Form of Cooperation in Medical Rehabilitation?

## Zespół interdyscyplinarny – czy w rehabilitacji medycznej występuje forma współpracy?

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### SUMMARY

The work is an attempt to highlight the problem related to too weak or even insufficient communication in a team integrating healthcare professionals and drawing attention to this very important aspect of caring for the patient without competing for the grandmaster's laurel. The definition of the term Interdisciplinary Team in the medical context is very simple. It is a group of people, specialists in various fields of medicine, dealing with solving a specific problem using the resources at the disposal of each member of such a Team. Polish realities in many cases are far from this concept, which, unfortunately, may result in worse therapy outcomes. Although each of the members of this team may think that his contribution is the most important, it is only the sum of all activities that translates into success, the effect of which is regaining the health lost by the patient, and this success is achieved by not one person but a multi-person team.

Currently, it is not possible to provide a patient with only one specialist with the full range of medical services guaranteeing success. Treatment is a complex process involving diagnosticians (imaging diagnostics, laboratory diagnostics), a doctor, physiotherapist, psychologist, dietitian, nurse and many other specialists without whom it is difficult to imagine any treatment activities. The group should be led by a leader, but information on the patient's health should be available to each member of the therapeutic team, and decisions should be made on the basis of joint arrangements, so that none of the team members "pulls in their way" but contributes to mutual success, what a healthy patient is.

The work raises problems such as the lack of reliability of information, points to the unfavourable phenomenon of "generalization" of disease entities and the frequent dissonance in the selection of appropriate therapeutic measures.

The article indicates only a few situations that cause inconsistencies in the patient's rehabilitation process. The rights and scope of the work of a physiotherapist on the basis of current legal documents were emphasized, the possibilities of extending the qualifications of physiotherapists were highlighted and the opportunities that would be granted to physiotherapists after obtaining additional qualifications were emphasized as well.

**Key words:** interdisciplinary team, physiotherapy, patient, communication

**Słowa kluczowe:** zespół interdyscyplinarny, fizjoterapia, pacjent, komunikacja

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In the case of medical rehabilitation, a fairly frequent phenomenon is the lack of cooperation between individual members of the medical staff forming the so-called interdisciplinary team. Undoubtedly, the entire treatment process is based on three main pillars, which Howard Rusek defined as the stages of the proper course of therapy, which include:

I - diagnosis, that is, correct diagnosis, giving a chance for a cure;

II - basic treatment usually based on surgery;

III - rehabilitation as an element of the fastest possible return to full fitness of the body.

Contrary to popular belief, rehabilitation does not involve healing the patient after the procedure, but is a comprehensive and complex treatment of the patient [1].

Each member of the interdisciplinary team should first of all take into account the good of the patient to which a common path leads, therefore the team's strength lies in the transmission of information, so that the therapy is carried out in one way and in order to strengthen the obtained effects of treatment. Often, the lack of information at particular stages of treatment, which may seem trivial or irrelevant, may lead to the loss of what has been achieved with the patient. This

can create a feeling of dissatisfaction and poorly done work among health care workers, and in the patient such a situation can lead to a loss of trust, health, or even life.

### THE LACK OF RELIABLE INFORMATION MAKES IT DIFFICULT TO PLAN AND CONDUCT REHABILITATION

It is quite a common problem in the rehabilitation world. As a rule, the order in the rehabilitation card includes basic exercises to be performed by the patient, which should be selected depending on the patient's condition (from passive exercises to standing upright). However, quite often there are cases where the commissioning of information about coexisting diseases or procedures performed by patients is not included in the ordering process. For physiotherapists, the failure to take into account information on diseases is an obstacle that effectively slows down the rehabilitation process. There is always an interview, that is, the basis of the study, but it unnecessarily binds the time that could be spent on therapy. For example, when considering a situation in which a geriatric patient with problems related to dementia or Alzheimer's disease is treated, obtaining information from such a person may turn out to be unreliable or even wrong. A family representative or caregiver can help, but is often absent when starting the rehabilitation process. Omitting "irrelevant information" for one professional group is of great importance for another, especially when creating and implementing a rehabilitation plan. An example is epilepsy. Failure to consider it as a disease entity may significantly hinder the patient's upright positioning. During the therapy aimed at improving locomotion, an epileptic seizure may occur (depending on the type of epilepsy, it may occur as a temporary loss of consciousness or strengthened by a seizure). The stronger the symptoms of epilepsy, the more dramatic outcomes the incident may have. The responsibility for the patient rests with the person conducting the exercises, that is, the physiotherapist. Knowing about the comorbid disease, the physiotherapist may take appropriate remedial measures in advance, for example in the form of securing the other person. There are many such cases and they can be multiplied endlessly, so at this point it is worth asking what to do to avoid such situations in the future. Of course, in each team there is a leader, that is a person whose task is a global assessment of the patient's needs, but it should be remembered that in modern medicine individual specializations have developed, and with them specific competences, therefore information is of fundamental importance influencing the course of therapy. This information should flow freely in every direction, as it is a strong guarantee of success, i.e. the recovery of health by the patient.

Medicine is a special example in which it can be seen that any information that may seem trivial may be of key importance and affect the success of therapy, which in the case of rehabilitation may be expressed in its modification by changing the intensity, number of repetitions, or its temporary or complete cessation. The current state of health of the patient, comorbidities, previous injuries or the conditions in which the patient functions are of key importance. It is like ignorance not to acknowledge such information. The prognostic indicator for the patient depends on making the right and wrong decisions. Unfortunately, in each disease, apart from indications, there are also contraindications

to physiotherapeutic procedures. Many disorders have their typical symptoms, in which the dynamics of accretion belongs to the system of "yellow and red" flags, and it does not happen without reason. Not taking them into account is a shameful mistake. Ignoring them may result in the worst possible scenario that no one wants to experience [2].

It is worth considering the approach to the initial diagnostic and therapeutic stage. The generalization of the patient's health problems in the form of "pain syndrome" is a kind of obstacle in the rehabilitation process. A complete diagnosis results in the physiotherapist's attention to the cause and not to the general problem. Incorrect or overly generalized diagnosis is a common cause of unnecessary delay of the patient's recovery. The possibility of insight into the updated history of the patient's disease gives a new quality of focusing the rehabilitation activities on the most important problem at the moment. An example of this is the quite frequent "Painful Shoulder Syndrome", where focusing only on the symptoms rarely brings the expected results. Unfortunately, as you can see, the failure to establish the root cause is quite a serious mistake. It is worth excluding bone and muscle-related causes, neural causes or previous injuries. Another aspect is the phenomenon of trigger points, which are often inadequate to the location of disease entities. Focusing all your attention on the wrong place will be counterproductive [3].

Another important problem concerns physical therapy. Quite often, treatments are ordered incorrectly, inadequate to the patient's health problems. It is also troublesome to determine their order, because treatments performed in the wrong order can reduce and cancel the effects achieved, and the point is to strengthen these effects. Knowing about their primary purpose and influence on the body is crucial. Physical stimuli have a high potency, but if administered improperly, they may not produce the intended effects. The most common reason for this is failure to take into account contraindications. Omission of the patient's current health condition and comorbidities for the purposes of rehabilitation may result in an extension of the hospitalization time, and thus extend the period of his recovery. Thanks to basic medical procedures, such as an interview, physical therapists are able to detect mistakes, but this involves time that should be allocated to specific activities. Another thing that inhibits the patient's rehabilitation process is combining treatments with completely opposite effects. We are talking here about the combination of cold therapy with heat therapy. It is true that both treatments come from the group of treatments classified as thermotherapy, but their simultaneous use does not bring any profit, and may even lead to tissue damage, for example by causing inflammation, which will also extend the patient's recovery process [4].

On the other hand, the use of combined methods means that, without detriment to the patient's health, the number of treatments used daily can be reduced, thus ensuring large time savings [5].

Thanks to the regulation of the Minister of Health on guaranteed benefits in the field of therapeutic rehabilitation of December 13, 2018, physiotherapists acquired the right to independently conduct the physiotherapy process, that is, to plan a therapy according to their knowledge, taking into account medical diagnosis. Thanks

to it, some procedures that were not prescribed by a specialist in the field of rehabilitation, but by a general practitioner, can be changed. This gives the opportunity to obtain better results in the rehabilitation process, which undoubtedly facilitates the development of the best rehabilitation plan for the patient.

Based on the Act on the Profession of Physiotherapists [6], from December 1, 2021, physiotherapists will be able to participate in a new program of specialization in the field of physiotherapy. Its main assumption is that the person undergoing the training will “deepen and improve the ability to comprehensively improve”. Additionally, thanks to the completion of the training, physiotherapists will be able to perform treatments that were previously performed by a doctor, that is:

- Performing ultrasound for the purposes of assessing the activities of the musculoskeletal system.
- Surface electromyography.
- Performing an ECG for physiotherapy.
- Conducting spirometric tests
- Chest auscultation assessment.

Obtaining specialization in the field of physiotherapy broadens the scope of physiotherapists' competences, for example with diagnostics, which will result in a more effective improvement process and also reduce misunderstandings in the interdisciplinary team. It is obvious that the training will take place for a group of physiotherapists who have met the requirements set out in the document regarding the specialization program in the field of physiotherapy [7].

#### IDEAL TEAM

In order for the cooperation in the team to be maintained, certain requirements that are standard in its functioning are necessary, which include:

- Clearly defined goal
- Appointing a leader
- Efficient communication
- Defined roles [8].

It is the last point that is a kind of barrier that prevents us from achieving the expected goal, that is, improving the patient's health. It may result from both an inappropriate approach to people with less experience and excessive belief in one's own abilities and competences [9]. Marking your comments about the rehabilitation process or taking into account your views should be a kind of expression of certain “modifications” that are not intended to “image”, but suggest changes aimed at improving the patient's prognosis. Unjustified outrage of one of the parties may be a kind of incompetence or disrespect towards other team members. Then it is worth trying to resolve conflicts, not to deepen them. Expressing your opinion about a different plan of the rehabilitation process should take place in a calm atmosphere, without too much negative emotions. Suggesting a certain change that may speed up the rehabilitation process should be taken calmly, and consulted with the doctor and the rest of the staff.

#### CONCLUSIONS

Currently, it is not possible to provide a patient with only one specialist with the full range of medical services guaranteeing success. Treatment is a complex process involving

diagnosticians (imaging diagnostics, laboratory diagnostics), a doctor, physiotherapist, psychologist, dietitian, nurse and many other specialists without whom it is difficult to imagine any treatment activities. The group should be led by a leader, but information on the patient's health should be available to each member of the therapeutic team, and decisions should be made on the basis of joint arrangements, so that none of the team members „pulls in their way” but contributes to mutual success, what is a healthy patient.

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# The Range of Physical Rehabilitation Methods in Children with Cerebral Palsy

## Zakres metod rehabilitacji fizycznej u dzieci z porażeniem mózgowym

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### SUMMARY

**Aim:** To analyze the modern national and foreign literature on up to date methods of physical rehabilitation of children with cerebral palsy.**Materials and Methods:** The study used bibliosemantic analysis of physical rehabilitation methods in children with cerebral palsy in ScienceDirect, PubMed, Scopus and Web of Science electronic databases. Inclusion criteria: (1) physical rehabilitation of children with cerebral palsy, (2) methods of physical rehabilitation of children with cerebral palsy. If the expected criterion was found, the full text was reviewed.**Conclusions:** The bibliosemantic review of literature sources indicated that a large set of new methods are used in the physical rehabilitation of children with CP. In general, a larger percentage of authors indicated the effectiveness of the methods of therapeutic physical exercising, rehabilitation massage, dosed proprioceptive correction, sensory integration, Vojta-Therapy, kinesiotherapy and kinesiotaping in the physical rehabilitation of children with cerebral palsy.**Key words:** physical rehabilitation, cerebral palsy, kinesiotherapy, sensory intergration**Słowa kluczowe:** rehabilitacja ruchowa, porażenie mózgowie, kinezyterapia, integracja sensoryczna

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### INTRODUCTION

Cerebral palsy is a very widespread developmental disability which is characterised by disorders of movement and posture causing activity limitation attributed to a static disturbance in the developing brain, often accompanied by associated impairments and secondary health conditions. CP combines disorders in various motor functions including but not limited to body movement, muscle control, muscle coordination, muscle tone, reflex, fine motor skills, gross motor skills, oral motor functioning, posture, and balance [1, 2]. From the perspective of International Classification of Functioning (ICF) it might be determined that CP has significant influence on a person's functioning (incl. body structures), body functions (e.g. intellectual), activities (e.g. walking) and participation (e.g. playing sport) which cause impairments, activity limitations and participation restrictions. As each person lives within a personalized environment and thus their context also contributes to determining their independence, comprising personal factors and environmental factors [2, 3]. In physical rehabilitation of children with CP varying approaches and techniques are used focus on function, movement, and optimal use of the child's potential and uses physical approaches to promote, maintain and restore physical, psychological and social well-

being within all environments of the child including home, school, recreation, and community environments. Recent recommendations emphasise on the necessity of the intensive rehabilitation which improves motor functioning in children with cerebral palsy by including motor learning theories [1, 4]. Neuroscientists state that central nervous system has the plasticity function and the potential to reorganize throughout the whole life. The plasticity depends on motor activity which is improved by task-specific exercises. Basing on this concept some effective interventions were developed [4, 5].

### AIM

The aim of the study is to analyze the modern national and foreign literature on modern methods of physical rehabilitation of children with cerebral palsy.

The task of the research is to conduct a bibliosemantic analysis of modern methods of physical rehabilitation of children with cerebral palsy.

### MATERIALS AND METHODS

The study used bibliosemantic analysis of physical rehabilitation methods in children with cerebral palsy in ScienceDirect, PubMed, Scopus and Web of Science electronic databases. Inclusion criteria: (1) physical rehabilitation

of children with cerebral palsy, (2) methods of physical rehabilitation of children with cerebral palsy. If the expected criterion was found, the full text was reviewed.

## REVIEW AND DISCUSSION

As a result of bibliosemantic review of the scientific literature was found that the effectiveness of physical rehabilitation of children with CP depends not only on their personal rehabilitation potential, which is influenced by concomitant somatic pathology, general psychophysical condition, autonomic regulation, etc, but also by the morpho-functional peculiarities of central nervous system (CNS) [4-7]. In this regard, it is necessary to identify somatic health disorders, disorders of psychophysical development, features of the functional activity of the body of children with cerebral palsy in the 1st year of life to increase rehabilitation potential and ensure effective physical rehabilitation [7-8]. Physical rehabilitation of children with cerebral palsy is regulated by orders of the Ministry of Health of Ukraine.

Specialists in Ukraine have conducted a lot of scientific studies on the level of morbidity of children with CP. As a result numerous methods and programs using the latest methods of physical rehabilitation of children with CP were created and implemented into practice [7, 9, 10]. The problem of the theoretical and methodological aspects of physical rehabilitation of children with CP and its effectiveness are still being studied [10, 11]. There is a significant percentage of studies that focus on improving the motor abilities of children with cerebral palsy through invasive intervention, medical correction [4, 11, 12].

The authors emphasize the expediency of using sets of exercises in the process of physical rehabilitation to correct and improve the motor abilities and to develop motor fitness of children with cerebral palsy [4, 8, 13].

In recent years, the special attention of foreign scientists Loggian M, Samuels M, Falconer J, Zager R. (1983) [13], Singhi P, Dayal D, Khandelwal N., (2003) [14], Tyson SF, Selley AB, (2007). [15], Varadharajulu G, Shetty L, Sahoo K. (2017) [16] was devoted to the study of the application of the Bobath Therapy method in the physical rehabilitation of children with cerebral palsy. The authors emphasize using also described this method of CP physical rehabilitation in their scientific works.

An important role in the physical rehabilitation of children with cerebral palsy is to restore normal movement in the joints and muscles using sets of exercises, rehabilitation massage, dosed proprioceptive correction, Bobath Therapy [17-20], Vojta-Therapy [21-22], kinesiotherapy and kinesiotopeing, etc. [23, 24].

Specialists in 227 "Physical Therapy, Occupational Therapy" in the field of knowledge 22 "Health" specialize in the restoration or development of motor skills through the development of physical qualities, assessing strength, endurance, range of motion, disorders of gait, speech, motility, cognitive functions to develop individual program of physical rehabilitation [26, 27].

Sets of exercises are one of the leading effective methods of physical rehabilitation of children with cerebral palsy, as a result of which children gain sufficient muscle strength and endurance, develop motor skills, develop proper breathing, increase exercise tolerance, normalize blood circulation, increases resistance to infections and improve emotional state. The use

of the developed complexes of therapeutic exercises in children with CP allows improving physical fitness, increases flexibility, strength endurance [18, 22, 28-29].

The main means of therapeutic physical training are different types of physical exercises as well as games. As a result of implemented programs, scientists noticed the formation or correction of gait skills, improved speech control, etc. [26, 28, 29].

Physical rehabilitation specialists prescribe rehabilitation massage to children which CP in order to reduce reflex excitability of muscles, prevent the development of contractures, stimulate the function of paretic muscles, improve lymph and blood circulation, reduce trophic disorders. Before the rehabilitation massage, it is necessary to ensure maximum muscle relaxation by choosing the correct starting position and proper relaxation exercises [28, 29].

Reviewing the latest methods of physical rehabilitation, it is recommended to point out the method of physical therapy "Vojta-Therapy", which was developed and implemented in practice by the Czech doctor Václav Vojta. As a result of studying and comparing the influence of crawling and overturning reflexes on the formation of the musculoskeletal system of a developing child normally and in pathology, the basis of the Vojta-Therapy method was determined. This method consists in the use of two coordination complexes aimed at stimulating the formation of these reflexes. Reflex locomotion is not aimed at training a specific movement, but at creating models of coordinated muscle work for the development of the elementary motor chain [19, 20].

Vojta-Therapy helps to restore natural patterns of movement as it affects existing nerve connections at different levels of the body. Vojta-Therapy uses the child's innate ability to perform natural body movements. This therapy is effective when it is used 3-4 times a day with the constant use of the method of Vojta-Therapy for at least one year. Exercises are performed by fixing the child in a certain starting position in a special reflex position, pressing on a certain area of the body, which is determined individually depending on motor disorders and the intensity of the corresponding reflex reactions [19, 20, 26].

The study on the application of the Vojta-Therapy method in children with cerebral palsy in an inpatient rehabilitation period showed that if practicing daily classes for 7 months, in about 10% of children, 7-12 months – about 30%, 12-36 months, about 40%, more than 3 years, about 20%, the first positive trend is observed in 2-3 weeks after starting therapy. It was manifested by improved movements in the shoulder joint. After 3-4 months of therapy a disappearance of the crooked neck, an increase in the amplitude of movements in the shoulder joints, balancing of muscle tone, a change in the position of the arms relative to the torso, a decrease in autonomic disorders were observed [19, 20, 26].

Jung, M. W., Landenberger, M., Jung, T., Lindenthal, T., & Philippi, H. (2017) [20] described that the Vojta-Therapy is incompatible with physiotherapeutic methods of electrical stimulation of muscles, which are included in the standard programs of physical rehabilitation of children with cerebral palsy as electrical stimulation is an apparatus procedure using

pulsed currents to enhance the activity of certain organs and systems. Such therapy of electrostimulation is used to restore the damaged functioning of the organs, muscles and nerves. The method of electrical stimulation therapy is included in the complex of rehabilitation treatment and for prophylactic purposes. For therapeutic purposes, electrical stimulation is often prescribed to restore the function of the damaged motor nerve, in paresis and paralysis, in neuritis of facial muscles, as well as spastic paralysis.

Bobat therapy, also known as neurodevelopmental treatment, is a rehabilitation technique that allows you to restore muscle tone, motor function of the musculoskeletal system. It bases on the observations of how the increased tonus influences the child's functional ability and aims at fine motor skills of the hands, and the restoration of nerve cells through the use of physical and mental exercises. The Bobath Therapy is a goal-orientated and task-specific approach, which focuses at organising the proprioceptive and exteroceptive environment of the nervous system for efficient functioning of the individual. Regular classes with children with cerebral palsy by the method of Bobat therapy can achieve positive results, such as: improvement of postural alignment, restoration of lost motor activity; postural self-organization; stimulating the correct perception of the own body; restoration of reflexes; partial reduction of spasticity; normalization of the general tone of muscles; prevention of contractures and deformities. Bobat therapy is congruent with the ICF and emphasizes on the integration of the postural control and task performance and selective movement control in order to do the coordinated sequence of movements. The efficiency of the application of Bobat therapy in rehabilitation of the children with CP is controversial and has insufficiency of evidence support [15, 17, 18, 26].

The method of dynamic proprioceptive correction is also used in the physical rehabilitation of children with cerebral palsy. The advantage of dynamic proprioceptive correction is the ability to adjust the afferent vestibulo-proprioceptive flow, which enters the central structures of the motor analyzer in the process of movement from all points of the musculoskeletal system, which performs the function of antigravity [10, 26, 31].

The design of the dynamic proprioceptive correction suits allows the links of the musculoskeletal system in the adjusted position to perform movements with the required amplitude. The purpose of the method of dynamic proprioceptive correction is the correction of motor disorders in children with cerebral palsy using reflex-loading devices and biodynamic corrector-suit. The objectives of this method are to reduce the intensity of pathological reflexes on the musculoskeletal system, muscle synergies, training of certain muscle groups, the formation of physiological motor stereotype [10, 22, 26].

The European Union scientists evaluated the effectiveness of physical rehabilitation using the method of dynamic proprioceptive correction in the physical therapy of children with CP with different levels of musculoskeletal disorders. In their scientific works they found that in children with the first level of motor development disorders the effect was minimal, the clearest positive changes were observed in children of the second and third levels, regardless of the form of cerebral palsy [1, 2, 10, 26]. In 72.3% of

children after the end of the course of physical rehabilitation and in 12.4% of post-primary classes there were positive changes in the psycho-emotional state. Recent studies of the effectiveness of the method of dynamic proprioceptive correction in children with cerebral palsy in the complex rehabilitation system showed a significant number of positive changes in patients' motor skills, and only a small percentage of patients moved to a higher level of motor development according to GMFCS classification [10, 22, 26].

The effectiveness of complex physical rehabilitation using the method of dynamic proprioceptive correction helps to increase the vertical stability by the results of computer stabilography, which is confirmed by the results of clinical and neurological examinations and indicates improved coordination in the same patients. Experts indicate the late start of dynamic proprioceptive correction method in the physical rehabilitation of children with cerebral palsy due to the incomplete formation of the spine musculoskeletal system at the early age [10-12, 14, 26].

It is necessary to highlight the method of VI Kozyavkin "System of intensive neurophysiological rehabilitation" – the multimodal rehabilitation system in which the influence of one component is complemented and intensified by the others. Biomechanical spine correction in combination with mobilizing and rhythmic gymnastics, massage, limb joint mobilization, mechanotherapy, reflexology and biodynamic movement correction programs are the main components of the system of intensive neurophysiological rehabilitation. The versatile therapeutic effect of the system of intensive neurophysiological rehabilitation is aimed at improving the child's vital functions [30, 31].

According to Kachmar OO, Kozyavkin VI, Voloshin TB, Vityk HO, Kalinovich NR (2016) [12], the method of VI Kozyavkin is one of the 4 most effective methods of physical rehabilitation of children with cerebral palsy.

The system of intensive neurophysiological rehabilitation is structurally and functionally divided into [8, 12, 26]:

- intensive correction, which is carried out in the rehabilitation center and lasts for 14 days;
- stabilization and potentiation of the therapeutic effect, which continues according to the recommendations at home for the next 6 months or 1 year until the next course of rehabilitation in the center.

The technique of biomechanical correction of the spine developed by VI Kozyavkin is the basis of the technology of intensive neurophysiological rehabilitation, which aims to eliminate functional blockades of the vertebromotor segments and restore or stimulate joint mobility to reduce central nervous system dysfunction. Spine correction is performed only after manual diagnostics and after specialized training of the patient. In the lumbar region, the manipulation technique is performed simultaneously on all blocked segments of the spine using the technique of VI Kozyavkin "rotation back". Unlocking of the segments of the thoracic region is carried out by pulse techniques from top to bottom in the exhalation phase. The cervical spine is corrected by the movement of a complex trajectory to ensure simultaneous impact on the blocked segments [30, 31].

The positive effect of the system of intensive neurophysiological rehabilitation method is due to the complex change in the

functional systems of the body, normalization of muscle tone, improving blood supply and tissue trophicity. According to VI Kozyavkin all components of the system of intensive neurophysiological rehabilitation should be used for effective physical rehabilitation [12, 30, 31].

The method of physiotherapy in the physical rehabilitation of children with CP is presented in many national fundamental scientific works. Modern scientists question the effectiveness of physiotherapy in this group of patients. According to scientific studies, the purpose of physiotherapy in the rehabilitation of children with cerebral palsy is to improve motor and mental functions of patients through the formation of postotonic reactions, normalization of central and peripheral nervous systems, reducing static and muscle rigidity. Interference currents, laser radiation, sinusoidal modulated currents are used in the physiotherapeutic complex [7, 14, 25, 26].

Taking into consideration the method of Kinesiology Tape, scientists have stated [23-25] that its therapeutic effect helps to activate the nervous and circulatory systems of a child with cerebral palsy. The Kinesiology Tape method is based on scientific research in the fields of kinesiology, physical rehabilitation, orthopedics, etc. The Kinesiology Tape technique involves the use of functional tapes that are applied over the muscles for 3-5 days during the period of 4-5 weeks. Classic tapes are applied to the affected joint to ensure immobilization immediately before exercise. The main effects of using the method of functional taping, regardless of the method of application, is the effect on muscle tone, i.e. either increases it or decreases, depending on the expected effect [23-25].

According to scientific papers, the Kinesiology Tape method is widely used and combined in the physical rehabilitation of children with cerebral palsy with methods such as Voita therapy and Bobat therapy [19, 21, 25]

According to a studies, using the method of Kinesiology Tape in children with cerebral palsy aged 1 to 14 years as the part of physical rehabilitation positive dynamics of stabilometric data was registered. The stability index, energy index in children with spastic hemiparesis form of cerebral palsy was changing within the 10 minutes, which indicates a restructuring of the postural regulation system. In children of the 1-3 years old and 2-14 years old with a clinical picture of severe process (the impossibility of verticalization), the dynamics of changes during KinesiologyTape was checked by determination of muscle strength, spasticity degree and measurement of range of motion. A 100% positive dynamics was observed in such a patients and the difference in data depended on the peculiarities of adaptive processes in the child's body [23-25].

In the clinical studies of a "Concept of 4 Tapes" – the Kinesiology Tape method – in hemiparetic form of cerebral palsy the pattern of walking and selective motor control were determined. The effect was estimated before and after the taping course. The positive dynamics manifested in the form of contractures weakening, reducing valgus positioning of the feet, improving the manipulative function of the hand, reducing hyperkinesis and hypersalivation [23-25]

Cerebral palsy has different forms with various degrees of CNS damage and impaired physiological functions of

the body. As the result of these processes the disorders of perception are observed. Due to disorders in perception, sensory interpretation is slowed down and incorrectly analyzed in the cerebral cortex. Therefore, it is essential to conduct sensory correction for children with this disease. Sensory integration is the process of receiving information from the receptors of all the senses by the nervous system, organizing them and interpreting in the way that they could be used in goal-directed activities. Sensory integration is based on the theory of sensory information processing, the study of higher cortical functions, etc. [1, 2, 4, 32]. In the process of child development on the basis of sensory experience, meaningful, appropriate behavior is formed and more complex activities are gradually mastered – from elementary movements to ability to learn and creativity. Impaired processing of sensory information at any level of the nervous system, which is observed in children with congenital or acquired lesions, negatively affects such important areas of life as motor skills, emotions, play, behavior regulation, learning ability and social interaction [2, 6, 10]. The aim of this method is to increase the ability of a child with cerebral palsy to perceive external information, to develop adaptive responses in accordance with psychoneurological needs [6, 10, 11].

The main task of sensory integration is to increase the frequency and duration of adaptive reactions based on the stimulation of mental and statokinetic development. Sensory integration aims to increase cognitive and motor activity, the amount and variety of different senses, to improve communication skills and the reaction to sensory stimulants. Sensory integration begins with the selective sensory input of the required information, the choice of environment, and the definition of the appropriate adaptive response and ends with the ratio of adaptive response to the child's ability to adapt and the implementation of adaptive response.

## CONCLUSIONS

The bibliosemantic review of literature sources indicated that a large set of new methods are used in the physical rehabilitation of children with cerebral palsy. In general, a larger percentage of authors indicated the effectiveness of the methods of therapeutic physical training, rehabilitation massage, dosed proprioceptive correction, sensory integration, Vojta-Therapy, kinesiotherapy and kinesiotaping in the physical rehabilitation of children with cerebral palsy.

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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

# State of Provision of Medical Rehabilitation to People with Disorders of the Musculoskeletal System at the Regional Level

## Regionalna dostępność rehabilitacji medycznej dla osób z chorobami układu mięśniowo-szkieletowego

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**SUMMARY**

**Aim:** To analyse the state of medical rehabilitation services for musculoskeletal disorders under contracts of the National Health Service of Ukraine (NHSU) at the regional level and identify possible problems in terms of health care reform.

**Materials and Methods:** Normative documents regulating the provision of rehabilitation care in the health care system of Ukraine, and published by the NHSU information on concluded agreements on medical care under the Medical Guarantees Program were used as materials of the study. The research embraced methods of system analysis, structural-logical analysis, medical-statistical, graphic and bibliosemantic methods.

**Conclusions:** The analysis of NHSU contracts in 2021 revealed that funding for packages of medical rehabilitation services for musculoskeletal disorders involves the provision of services in 129,170 cases, which is only 0.8% of the 2019 need. It was established that in Transcarpathian region in 2021 the amount of contracting for medical rehabilitation for musculoskeletal disorders was 45.4% of the funds for all rehabilitation packages in the region. With the increase in the total funding of signed contracts in the region, the number of projected cases of rehabilitation care in this area decreased by 9.9%. The provision of medical rehabilitation services for musculoskeletal disorders in Ukraine is insufficient and does not cover the potential needs of the population. At the regional level, there is a decrease in the number of planned cases of such services, but an increase in the number of health care facilities that provide them.

**Key words:** rehabilitation, musculoskeletal system, disorders, injuries

**Słowa kluczowe:** rehabilitacja, układ mięśniowo-szkieletowy, zaburzenia, urazy

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**INTRODUCTION**

In 2017, «Rehabilitation 2030: a call for action» meeting hosted by the World Health Organization announced the huge need for rehabilitation services worldwide, especially in low- and middle-income countries [1]. The need for rehabilitation services is growing every year, as rehabilitation is a set of interventions needed by a person who experiences limitations in daily physical, mental and social functioning due to aging or health condition, including injuries [2]. According to a study of the Global Burden of Disease, it is known that worldwide in 2019, rehabilitation would be beneficial to a large number of people (2.41 billion people), of whom 71% are people with musculoskeletal disorders (1.71 billion people) [3]. According to the WHO (Rehabilitation Needs Assessment) in Ukraine in 2019 rehabilitation was needed in 21 million cases (47.3 per 100 thousand population), of which 17 million cases

are disorders of the musculoskeletal system (39.3 per 100 thousand population) [4]. In Ukraine, over the past 5 years, much has been done to develop the field of rehabilitation: the creation, training and employment of new rehabilitation specialists (physical medicine and rehabilitation physicians, physiotherapists, occupational therapists), the introduction of the International Classification of Functioning, Disability and Health, expanding knowledge about rehabilitation among Ukrainian communities and decision makers [5]. An important step was the adoption of the Law of Ukraine “On Rehabilitation in Health Care” on December 3, 2020, which improved and systematized the legislative regulation of rehabilitation in health care [6]. It is important that medical rehabilitation is recognized as a component of medical services in the Medical Guarantees Program in accordance with the Law of Ukraine № 2168-VIII “On State Financial Guarantees of Medical Care”

of 19.10.2017. And from April 1, 2020, as part of the provision of specialized medical care to the population, the National Health Service of Ukraine (NHSU) began contracting health care facilities for medical rehabilitation packages. But there are still many obstacles to ensuring the full rehabilitation of the population in need, especially at the regional level and in remote settlements.

### AIM

The aim of this article is to analyse the state of medical rehabilitation services for musculoskeletal disorders under contracts of the National Health Service of Ukraine at the regional level and identify possible problems in terms of health care reform.

### MATERIALS AND METHODS

Normative documents regulating the provision of rehabilitation care in the health care system of Ukraine, and published by the National Health Service of Ukraine (NHSU) information on concluded agreements on medical care under the Medical Guarantees Program were used as materials of the study [7]. The research embraced methods of system analysis, structural-logical analysis, medical-statistical, graphic and bibliosemantic methods.

### REVIEW

According to the Law of Ukraine № 2168-VIII “On State Financial Guarantees of Medical Care” of 19.10.2017 medical rehabilitation is defined as one of the components of the *Medical Guarantees Program* [6]. As a result of the reform of the health care system of Ukraine, the algorithms for financing and providing medical services at all levels of medical care have been changed. In 2020, the Procedure for implementing this Program was approved by the Decree of the Cabinet of Ministers of Ukraine № 65 “Some issues of implementation of the program of state guarantees of medical care in 2020” dated 05.02.2020 [8]. As a result, since April 2020, for the first time, the implementation of medical rehabilitation services as specialized medical care has been introduced through funding from the National Health Service of Ukraine (NHSU). In 2021, the Procedure was approved by the Decree of the Cabinet of Ministers of Ukraine № 133 “Some issues of implementation of the program of state guarantees of medical care in the II-IV quarters of 2021” dated February 15, 2021. These documents allow for the provision of medical rehabilitation services in 3 packages: “Medical rehabilitation of infants born prematurely and/or ill during the first 3 years of life”, “Medical rehabilitation of adults and children over 3 years of age with musculoskeletal disorders”, “Medical rehabilitation of adults and children over 3 years of age with lesions of the nervous system”.

Therefore, people with musculoskeletal injuries, diseases of the musculoskeletal system in the subacute and recovery period can receive rehabilitation services under the package “Medical rehabilitation of adults and children over 3 years of age with musculoskeletal disorders.” The package includes an initial examination and consultation, rehabilitation diagnosis, prognosis, individual rehabilitation program and provision

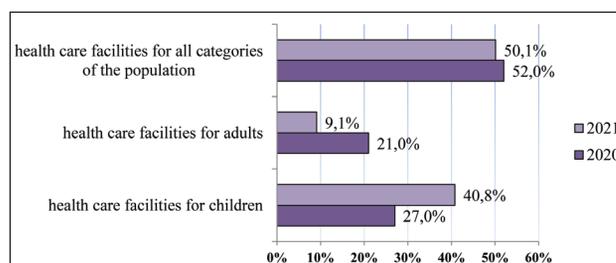
of medical rehabilitation services [8, 9]. The tariff for medical services of this package is set as a global rate for readiness to provide such services and is calculated on the basis of the rate for the treated case, which in 2020 amounted to 6,554 UAH, and in 2021 increased by 18% to 7,729 UAH.

In total, in 2021, the National Health Service of Ukraine (NHSU) contracted health care facilities for all medical rehabilitation packages in the amount of 1,639,575,957 UAH. The package for the musculoskeletal system disorders was signed by 285 health care facilities for a total of 998,354,930 UAH which is 60.9% of the total amount for rehabilitation. Taking into account the tariffs of 2021, it can be determined that the provision of medical rehabilitation services is foreseen in 129,170 cases of musculoskeletal disorders. 97.5% of the total number of these health facilities are communally owned and only 2.5% are privately owned.

In Transcarpathian region in 2020, the total amount of all contracts of the National Health Insurance Fund for medical rehabilitation of persons with musculoskeletal disorders amounted to 7,703,244 UAH, and in 2021 it increased by 6.3% and amounted to 8,185,011 UAH. This is a very small share (0.8%) of the total in the whole country. A detailed analysis shows that the funds in 2021 for medical rehabilitation for musculoskeletal disorders amounted to 45.4% of the funds contracted for all three rehabilitation packages in the region. It should be noted that the contracted amounts of money allowed for the provision of services in 1172 cases of musculoskeletal disorders, and in 2021 accordingly in 1059 cases. Thus, with the increase in the total funding of signed agreements in the region, the number of projected cases of rehabilitation assistance in this area decreased by 9.9%.

It was determined that in 2020, 27% of the planned funding is intended for institutions that provide medical services only to children, 21% - for those that serve the adult population, and respectively 52% - for health facilities that provide services to all age groups (Figure 1). In 2021, the situation has changed - the share of funds allowed for the provision of rehabilitation services for musculoskeletal disorders for health care facilities that serve only children has increased to 40.8%. The share of funds for institutions that serve only the adult population also decreased by more than 2 times (up to 9.1%).

In Transcarpathian region only 7 health care facilities in 2020 and 9 facilities in 2021 concluded the agreements



**Figure 1.** Comparison of financing of health care facilities under the package of medical rehabilitation to people with disorders of the musculoskeletal system in terms of the target group of services provision

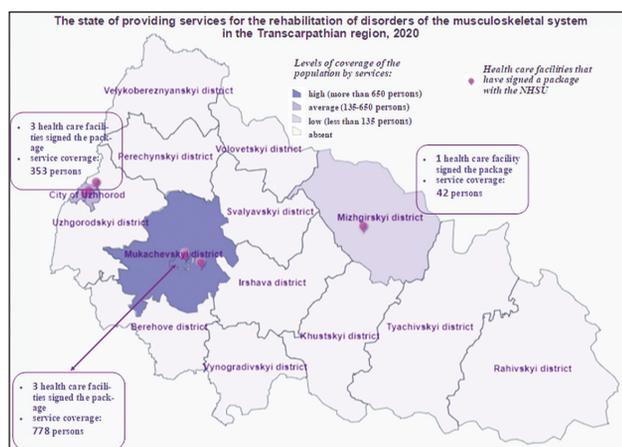
with the NHSU under the package of medical rehabilitation services for musculoskeletal disorders. 4 health care facilities from those specified in 2020 were property of the Regional Council and served the population of the region, 2 facilities provided services to the population of two separate districts of the region (Mizhhirya and Mukachevo), and 1 health care facility - to the children's population of the regional center (Uzhhorod) (Figure 2).

The analysis showed that in 2021 the situation changed slightly, because one of the institutions was merged with another regional institution. There also appeared 3 more health care facilities in the region that have signed contracts that include medical rehabilitation for musculoskeletal disorders. These are 2 regional specialized health care institutions and one district facility. Thus, from April 2021 in Transcarpathian region, medical rehabilitation services for musculoskeletal disorders can be provided by 9 health care facilities: 5 institutions of the Regional Council (1 specialized institution, 3 general institutions and 1 rehabilitation institution for children), 3 facilities of District Councils (Mizhhirya, Mukachevo, Rakhiv) and 1 institution of the City Council (Uzhhorod) (Figure 3).

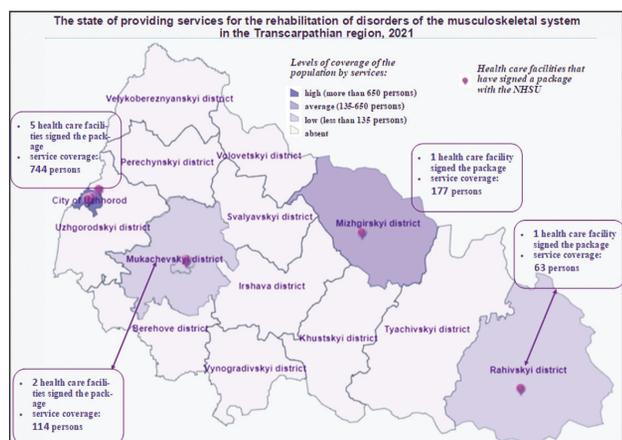
## DISCUSSION

The current state of health care reform in Ukraine has expanded the possibilities of providing medical rehabilitation services by health care facilities [10]. But did it allow to receive the specified services to persons with diseases of the musculoskeletal system irrespective of a residence? It is known that 71% of all those who were in a condition in which rehabilitation would be useful needed such services in the world in 2019 [3]. In Ukraine, the share of cases with musculoskeletal disorders was 81% (17 million cases), of all those in need of rehabilitation in 2019 [4]. An analysis of NHSU contracts in 2021 revealed that funding for medical rehabilitation packages for musculoskeletal disorders involves the provision of services in 129,170 cases, which is only 0.8% of the 2019 need identified by the WHO Rehabilitation Need Estimator [4]. This is a very low level, although better than nothing at all.

In order to better understand this difference, we analysed the possibilities and dynamics of changes in the provision of medical rehabilitation services for musculoskeletal disorders at the level of one region of the country – Transcarpathian region. The analysis revealed that the provision of services can be assured territorially only to the population of the regional center and three districts of the region according to the old administrative division (Figure 3). It should be noted that in 2020 the services were available to the population of only 2 districts (Figure 2). The population of other districts can receive rehabilitation services for musculoskeletal disorders only in the institutions of regional subordination of the tertiary level of health care. Moreover, some of these institutions are highly specialized (Center for Neurosurgery and Neurology, Hospital for War Veterans, Children's Sanatorium). Thus, for the majority of the population of the region, medical rehabilitation services for musculoskeletal disorders are not yet available. What could this be related to? It can be assumed that this situation is related to several aspects. The first aspect is the inability to sign contracts for medical rehabilitation with the National Health Service of Ukraine due to insufficient provision of health care facilities in the regions with relevant specialists. After all, in the conditions of purchasing services under the package of medical rehabilitation, the need to ensure the work of a multidisciplinary team (physical medicine and rehabilitation physicians, physical therapist, occupational therapist and others) is clearly indicated [9]. Normative documents and a number of measures in Ukraine bring the potential provision of these specialists as close as possible [5]. But there are still very few such specialists in local health care facilities. This may also be due to low pay, which leads to the refusal of rehabilitation professionals to work in public (municipal) health care facilities. Another aspect is the low capacity of individual health care facilities to predict the number of services per year. This was reflected in a decrease in the total number of planned cases of medical rehabilitation package for musculoskeletal disorders in Transcarpathian region by 9.9% in 2021 compared to 2020. This situation arose due to a decrease in the projected cases for a third of



**Figure 2.** The state of providing services for the rehabilitation of disorders of the musculoskeletal system in the Transcarpathian region, 2020



**Figure 3.** The state of providing services for the rehabilitation of disorders of the musculoskeletal system in the Transcarpathian region, 2021

contracted institutions by more than 50%. Another third of health care facilities were able to receive funding for more cases than in 2020. And 3 institutions were contracted for the first time under this package, so their capacity can be assessed by the results of 2021.

## CONCLUSIONS

The provision of medical rehabilitation services for musculoskeletal disorders in Ukraine is insufficient and does not cover the potential needs of the population. At the level of Transcarpathian region, there is a decrease in the number of planned cases of providing services, but an increase in the number of health care facilities that provide such services. This allowed to expand the coverage of the population with medical rehabilitation services for musculoskeletal disorders. However, there is still a significant part of the region's population which has limited access to these services.

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# Particularities of Multidisciplinary Approach in Physical Therapy

## Cechy charakterystyczne wielodyscyplinarnego podejścia w fizjoterapii

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### SUMMARY

**Aim:** The aim of the work was to reveal the peculiarities of implementation of a multidisciplinary approach in a system of physical therapy.**Materials and Methods:** Theoretical analysis and systematization of data of scientific-methodical literature, data of Internet network.**Conclusions:** Implementation of the rehabilitation program is defined as a comprehensive task that requires participation of a team of specialists, where everyone has a list of specific and interchangeable functions. Each of the specialists in the multidisciplinary team is responsible for the patient. At the same time, building of the rehabilitation program, choosing of strategies and means are subordinated to the commonly developed goal.**Key words:** rehabilitation, multidisciplinary approach in physical therapy, stroke and cancerous diseases, infantile cerebral palsy (ICP), dystrophic lesions of the spine**Słowa kluczowe:** rehabilitacja, multidyscyplinarne podejście w fizjoterapii, udar mózgu i choroby nowotworowe, dziecięce porażenie mózgowie, zmiany dystroficzne kręgosłupa

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### INTRODUCTION

Nowadays, one of the most important and socially significant areas of modern medicine is rehabilitation, which gains more and more development every year, attracting significant number of specialists (researchers, physical therapists, psychologists, correctional teachers) around the world.

Analysis of data from recent publications, seminars and conferences conducted on the problems of assisting people with disability and various diseases, points out the need to revise usual set of techniques and methods of physical therapy, approaches in drawing up plans of interventions and evaluation of their effectiveness.

The modern model of rehabilitation requires consideration of assessment of motor disabilities' severity. Given this assessment, one can choose the optimal type and method of rehabilitation in each case.

Analyzing a specific patient (client), we see a number of problems, and the task is to consistently assess their severity and urgency. Problem-oriented approach does not change the number of problems, but outlines a constructive way of work, greatly simplifies and optimizes tasks for specialists, as attempts to solve a large number of problems in a short period of rehabilitation at the same time usually turn out to be ineffective.

While preparing the physical therapy program, it is mandatory to set a specific goal of the general plan of

interventions, taking into account the peculiarities of person's condition at the time of intervention. When choosing the type of intervention, it is necessary to focus on evidence-based medicine data about effectiveness of certain methods to achieve the desired result.

Providing rehabilitation care to patients has a number of specific features: staging, continuity, consistency, starting as early as possible, individuality, social orientation, active participation of the patient and his family in the rehabilitation process, multidisciplinary approach.

To draw up a specific plan of rehabilitation measures, the goals of the process should be as accurate as possible. They must be aimed at having following effects: restorative (in case of aim to save the working capability, positive prognosis), supportive (in case of reduction or complete loss of working ability, adaptation to the restructuring of functioning in organs and systems) and palliative (for creation of comfortable conditions for the patient's existence in the process of progression and generalization of the disease).

### AIM

With the above, the aim of the work was to reveal the peculiarities of implementation of a multidisciplinary approach in a system of physical therapy.

To achieve it, the following purposes were determined:

1. to analyze the essence of the multidisciplinary approach in a system of physical therapy and particularities in forming a multidisciplinary team (MDT).
2. to describe using the multidisciplinary approach in a system of physical therapy in different groups of patients.

## MATERIALS AND METHODS

Theoretical analysis and systematization of data of scientific-methodical literature, data of Internet network.

## REVIEW AND DISCUSSION

There are many approaches to rehabilitation both in Ukraine and abroad. In Ukraine, medical rehabilitation has been actively developed and gained immense popularity in many areas of practical health care over past decade. But the problem of accessibility, timeliness and quality of complex rehabilitation remains relevant.

For example, when prescribing rehabilitation measures, native specialists often limit it to recommendations on how to recover after discharge from the hospital. This situation can still be observed in most native clinics and hospitals. This problem is quite clear, because rehabilitation is a costly event that requires participation of many specialists, equipment, comfortable places of staying and a long time for implementation of the rehabilitation program. Many governmental institutions are unable to provide these conditions. However, recently, a sufficient number of public and private rehabilitation centers, where experienced and highly qualified specialists work, have created the multidisciplinary teams for city hospitals. At the same time, multidisciplinary rehabilitation is still poorly implemented in medical institutions and rehabilitation centers.

Restoration of lost functions after injuries and diseases, based on the experience of European clinical neuropsychologists, today has been developing better abroad than in Ukraine. In the UK, the rehabilitation process relies on a biopsychosocial, holistic approach, characterized by combination of individual and group treatment, a combination of work to restore cognitive functions and psychotherapeutic effects. The main parts of this approach include therapeutic environment, general understanding of goals and close contact inside the interdisciplinary team, purposeful activities and actions important to the patient himself, studying of compensatory strategies and retraining practical skills, working with families and caretakers [1].

The multidisciplinary approach in rehabilitation is not new for domestic experience. It was first mentioned by V. Bekhterev, when creating the Psychoneurological Institute in St. Petersburg. His thesis on the need of multidisciplinary study of neuro-mental system in healthy and sick people, developed and presented in the early twentieth century, has only recently become universally recognized by world scientific community. The need in multidisciplinary approach was justified by V. Bekhterev on the basis that task of studying the neuro-mental sphere in person is so huge that it can be adequately solved only with a large complex of human sciences, such as psychiatry, neurology, neurosurgery, neurophysiology,

psychohygiene, psychoprophylaxis. At the same time, what he meant not a mechanical association of different disciplines that study certain aspects of human behavior, but their integrative synthesis, which allows a holistic, comprehensive study in healthy and sick person at any stage [2].

Modern development of physical rehabilitation is aimed at creation of multidisciplinary rehabilitation centers with inpatient and clinic departments, completed with following profiles: cardiology, neurology, oncological pathology, traumatology, perinatology, etc. Rehabilitation should be adapted to the constantly changing structure of diseases, as well as technical progress and changes in social structures (flexibility), manageability, indications that may change in a process.

A multidisciplinary team of specialists is a group of specialists from different spheres, united by common goals. It is characterized by coordinated goals and clear purposes, certain functions, distribution of functions and responsibilities. The main principle is a synergy.

The multidisciplinary team is characterized by the following features:

- common goal;
- distribution of responsibilities and tasks;
- communication, awareness;
- mutual support;
- reaching consensus;
- social partnership;
- compulsory general combined training;
- analysis of activities.

The multidisciplinary rehabilitation team includes: a doctor, a physical therapist, an ergotherapist, a psychologist, a correctional teacher, a social worker, a patient, members of his family or caretakers. Proper organization of quality care can be much more important than the absolute time of therapy [3].

Patients of inpatient and outpatient departments should have access to the following functional units:

- kinesiotherapy department (alone or in combination with physiotherapy department) with a physical training room, preferably with rooms for bio-management and ergotherapy (household rehabilitation);
- physiotherapeutic department with offices for therapeutic massage, electrostimulation and acupuncture;
- office of psychologist and correctional teacher;
- functional diagnostics office [4].

Team members need to develop a comprehensive individual rehabilitation plan, taking into account the severity of the disease, needs and goals of the patient. This plan should be regularly updated on the his condition, correction of the rehabilitation goal and measures used [4].

The development of the rehabilitation plan should be based on the assessment of functional dysfunctions made with standardized, valid assessment scales and meet the needs and level of patient tolerance to physical exertion. Each patient with mobility limiting should be examined by a specialist to determine the most suitable and safe release methods [4].

Members of the multidisciplinary team should communicate with patient, his relatives or caretaker regularly, to involve them in the process of treatment and rehabilitation, set the aims and plan discharge together. Caretakers of the patient and staff should be trained to use appropriate methods of release and movement techniques individually for each patient. The rehabilitation process has to be built in a way to promote constant using of skills, obtained during rehabilitation, or during patient's daily activities [4].

Thus, the rehabilitation process is aimed at returning patient to independent functioning, while he/she is considered as an active participant and partner of this process. Implementation of the rehabilitation program is defined as a comprehensive task that requires participation of a team of specialists, where everyone has a number of specific and interchangeable functions. For example, any of the specialists in the multidisciplinary team should be responsible for the patient. At the same time, building a rehabilitation program, choosing strategies and means are subject of the commonly developed aim, which leads to solving of practical tasks for patient's social inclusion [4].

Among many nosological trends, physical therapy was and remains particularly in demand after strokes, cerebral palsy, dystrophic lesions of the spine, cancerous diseases.

The features of the multidisciplinary approach of the above-mentioned nosologies will be revealed in detail, basing on the the client-oriented approach.

#### MULTIDISCIPLINARY APPROACH IN POST-STROKE REHABILITATION

Lack of timely and adequate restorative treatment in patients after stroke leads to irreversible anatomical and functional changes, as well as social and household disadaptation of patient. The purpose of rehabilitation process is to return patient to everyday activities and working process, to create optimal conditions for his participation in public life. During rehabilitation it is important to keep in mind the idea of organization of physiological and pathological movements, formation of compensatory processes of damaged structures and functions, functional systems of the body.

Compliance with the multidisciplinary principle in rehabilitation after stroke is one of the conditions for effective recovery with top-priority. To implement this principle, it is necessary to have multidisciplinary teams in departments, to treat patients after stroke on inpatient, outpatient and domestic rehabilitation level. Those specialists function as a single team with clear coordination of actions, thereby, providing a purposeful approach to conduct rehabilitation activities among patients who have suffered a stroke [5].

The main activities of MDT are examination of patient by all member specialists, assessment of his state and degree of dysfunctions with further filling of special documents, common setting of treatment goals, creating an adequate environment for the patient depending on his needs, discussion of the peculiarities of patient's management, distribution of the terms of discharge, including timely planning, determination of the conditions for further treatment to achieve maximum independence in everyday life (rehabilitation in inpatient,

outpatient, domestic, sanatorium conditions), assessment the ability of relatives and caretakers to learn the techniques of care and assistance, drawing up plans for the rational management with the patient and his relatives [6].

To ensure coordination and consistency of actions of all MDT members, it is necessary to hold meetings to develop a strategy and tactics of treatment. The tasks of the MDT meeting are acquaintance of all members with patient, identification of patient's problems, setting a real treatment goals and coordination of appropriate actions to achieve them, notification to team members about positive or negative changes in patient's condition, as well as drawing up an extract plan.

The functions of the MDT doctor include: identifying the main medical problems of the patient and the goals of rehabilitation, diagnosing and treating of comorbidities, introducing modern methods of rehabilitation in team activities, coordinating the team work [7].

The functions of the physical therapist and methodist of therapeutic physical training in MDT are: detailed assessment of the severity of patient's motor and sensitive disorders; restoration of motor functions (ability to turn, move to a sitting and standing position, keep balance while sitting and standing, walking, grab and transport objects); working with patients in order to reduce manifestations of diseases of the chest area; advising nurses and other staff on correct positioning of the patient, training in movement, proper handling of the affected limbs in order to avoid pain, prevention of shoulder pain and management of patients with pain; advising on the use of walking tools; assessment of swallowing function to select proper position for patient's feeding, as well as participation in assessment of patient's daily activities [4].

The functions of the MDT ergotherapist include: assessing the patient's condition in order to identify how one or other disorder affect his daily activities self-service and leisure activities; finding out patient's risk of stroke and assessing everyday his common domestic conditions; setting the main priorities of the restorative process in patients; assessing the function of visuospatial perception; training to restore daily activity in patient; promoting patient's adjustment to everyday activities and supplemental subjects (selection of rocking chair, seat height, table, household appliances, kitchen tools and cutlery, etc.); using of auxiliary devices to improve patient's functionality [8].

Correction teacher of the MDT assesses the safety of patient's swallowing; conducts training of nurses, patient and his relatives to get skills that will overcome swallowing disorders and avoid aspiration; provides selection and modification of the diet; assesses problems of communication in patient; conducts classes on the recovery of speech disorders; teaches patient and caretakers on methods that allow patient to communicate, using oral or written language, as well as alternative methods of communication [8].

It is also advisable to include a psychologist, neuropsychologist, manual therapist, reflexotherapist, orthopedic pedotherapist, assistant of middle grade medical staff and assistant methodist of exercise therapy, nutritionist, leisure coordinator and social worker to the MDT.

## MULTIDISCIPLINARY APPROACH IN REHABILITATION OF CHILDREN WITH CEREBRAL PALSY

Analysis of the latest data indicates the need to revise usual set of techniques and methods of physical rehabilitation, approaches in drawing up plans of interventions and evaluating effectiveness of rehabilitation in children with cerebral palsy [9].

Modern rehabilitation model provides a mandatory assessment of the impairment severity in child's motor functions by the GMFCS (Gross Motor Function Classification System) scale. Considering the age, assessment of the condition, the index by GMFCS classification and rehabilitation potential of the child, one can choose the optimal type and method of rehabilitation in each particular case [10].

Many methods of rehabilitation, traditionally used in the restorative treatment of children with pathological changes in muscle tone (primarily of the spastic type), these days receive scientific justification from the point of neuronal plasticity. However, scientific knowledge about the reserves and possibilities of the nervous system is supplemented every day, which requires constant revision, reevaluation and improvement of existing and re-introduced methods of rehabilitation [11].

In order to maximize the implementation of modern neurorehabilitation methods, it is necessary to solve problems that interfere with formation of a new, functionally beneficial motor stereotype. There is a serious problem, that interferes with development of motor functions in cerebral palsy, namely, spasticity. The existing increasing in muscle tone gradually leads to limitation of functionality, formation of motor deficiency, decreasing of movement skills; complicates self-service; promotes appearance of pathological states, formation of contractures, subluxations and dislocations of the joints. In fact, spasticity can lead to a whole complex of motor disorders, and in some cases - to the total immobilization of the patient [6].

In addition to spasticity, a critical part in the formation of pathological motor stereotype in cerebral palsy are played by a dysfunction of reciprocal inhibition, appearance of pathological synergies and synkinesia, increasing of reflex excitability (enhanced startle reflex) and presence of pathological tonic reflexes (tonic labyrinthine, symmetrical tonic neck, assymetric tonic neck types), the effect of which appears the most during body position changing [5].

The optimal is a set of methods, which takes into account all the above aspects of motor disorders in children with cerebral palsy.

Physical therapy classes are conducted with setting a specific goal of the general plan of interventions, keeping in mind the current condition of the child. When choosing the type of intervention, it is necessary to focus on evidence-based medicine data on the effectiveness of certain methods to achieve the desired result [12].

Rehabilitation intervention also includes teaching the family and child how to function optimally in specific conditions and environment relevant to them. Classes with this approach can only be individual. Group classes serve as an application that helps the child to interact in a social environment.

Rehabilitation measures are divided into two types:

1. Activities aimed at improving the quality of movement performance, expanding motor potential, mastering new skills.
2. Measures aimed at preventing secondary orthopedic complications [13].

When drawing up a program for helping a child with cerebral palsy, its ability to move, keeping posture, participate in daily activities, and ability to communicate are taken into account.

Thus, methods of physical therapy can increase the effectiveness of rehabilitation measures. The consistent use of these methods of physical therapy, which take into account the features of motor and proprioceptive disorders of each child, in combination with correct work with parents, allows to realize the potential motor capabilities of each patient. A multidisciplinary approach in the rehabilitation of children with cerebral palsy, characterized by an early onset, a balanced combination of methods of physical rehabilitation with medication, physiotherapy, psychological and pedagogical support, helps to adapt the child to conditions of the society as much as possible.

## MULTIDISCIPLINARY APPROACH IN REHABILITATION OF CANCER PATIENTS

Today, medicine has reached a high level in diagnostics and treatment of patients with various forms of cancer, which allowed to increase life expectancy and achieve five-year survival in about 70% of cancer patients [14]. Despite this, the results obtained can not be considered satisfactory, since the success of the diagnostics and treatment is determined not only by the number of lives saved, but also by the number of patients who were able to feel like members of society after treatment, which is more relevant [15].

The main methods of treatment in cancer patients are aggressive surgical intervention, radiation, drug and hormone replacement therapy, which are widely used in oncological practice and are often accompanied by serious functional disorders of various systems and processes of the body, decreasing in performance, changings in social status and quality of life [11]. In this way, the ultimate goal of the therapeutic process in oncology should be considered not only as the clinical recovery in patient, but also his or her return to the usual lifestyle [16].

Comprehensive multidisciplinary rehabilitation care for patients, regardless of the nosological form and localization of the tumor, should include several stages: preparatory (development of an individual and the most effective plan for diagnostics and treatment, minimization of the risk of complications and tumor relapse), therapeutic (conducting organ-saving and reconstructive-restorative operations), early recovery (development of comprehensive rehabilitation programs aimed at prevention and treatment of general and local postoperative complications, early radiation reactions, side effects of chemotherapy) and late recovery stage (self-rehabilitation, social adaptation and vocational rehabilitation) [17].

Medical rehabilitation in patients should be carried out by a group of specialists: oncologist, endocrinologist, sexopathologist, psychotherapist, physical therapist, ergotherapist, functional diagnostician, social worker. All mentioned implies a multidisciplinary character.

In recent years, many foreign publications devoted to the rehabilitation of patients often encounter the concept of "prehabilitation", which is the process of patient's undergoing rehabilitation procedures in the period between the moment of diagnostication and beginning of treatment [17]. It is considered as a stage preceding medical rehabilitation, which allows to provide timely psychological assistance to the patient already from the moment of diagnostication. This is due to the fact that starting the moment of diagnostication of disease or suspicion on it in cancer patients, so-called reactive states often arise; they require psychorehabilitation measures [18]. Also, at the stage of prehabilitation it is possible to inform early specialized rehabilitation centers, offices of oncologists and rehabilitation specialists that there is a new cancer patient who will need medical rehabilitation, which will help to optimize their work and achieve high results at all stages of treatment and rehabilitation of this patient.

The duration of therapy of various malignant neoplasms is often long-term, from several months to years. As a result of a comprehensive course of treatment, all cancer patients need systematic observation and counteraction to recurrent measures [9].

An important point during medical rehabilitation measures is diagnostical screening, which is carried out at all stages of the rehabilitation process and includes laboratory (cancer markers) and instrumental diagnostics (ultrasound) methods, computer tomography (CT) and magnetic resonance imaging (MRI), positron emission tomography (PET), necessary for timely detection of complications, relapses and metastases after treatment, as well as for prognostic assessment of the tumor process [19].

Thus, on the basis of rehabilitation centers and institutions of sanatorium profile, it is necessary to form laboratory and diagnostic offices for systematic monitoring of health in cancer patients throughout the recovery period.

Currently, in the practice of medical rehabilitation in cancer patients around the world, various modern rehabilitation measures are actively used; they include physiotherapy, spa treatment, psychotherapy, dietotherapy, herbal medicine, immunotherapy.

#### MULTIDISCIPLINARY APPROACH IN THE SYSTEM OF REHABILITATION IN PATIENTS WITH DYSTROPHIC LESIONS OF THE SPINE

Dystrophic lesions of the spine are the most common chronic human injuries. Pronounced clinical manifestations of neurological disorders are observed during active work life period (age of 25-55 years) and represent one of the most frequent causes of temporary disability and valetudinarianism [20].

Even during remission, many patients have a feeling of discomfort when moving and at rest, which often decreases

their quality of life. This inevitably affects the productivity of mental and physical work.

Polymorphic therapeutic methods of treatment of this disease are often not quite effective and require further restoration of the functions of certain organs and systems [21]. Neurosurgical correction of lumbosacral discogenic pain syndrome in most cases leads to objective improvement of the condition. However, the pain syndrome does not disappear immediately and completely, in some cases deterioration in health conditions and quality of life of patients take place. As the result, they suffer from further decreasing of their performance, which causes the need for intensive rehabilitation, taking into account clinical manifestations and individual personal characteristics. This is a part of a complex multidisciplinary system of rehabilitation effect on the body, including all aspects of rehabilitation: psychological, medical, physical, professional, social, economic [16].

Among the methods of medical rehabilitation, the emphasis is on kinesiotherapy in the gym and hydrokinesiotherapy. Physical exercises are done in the position of gravitational discharge: while lying on the back, on the abdomen, on the side, in the knee-brush position. Principles of kinesiotherapy include: stabilization of the vertebral and motor segments, normalization of muscle tone (relaxation of spasmed muscles, stimulation of the relaxed ones), "construction" of the muscle corset, formation of physiological posture, creation and consolidation of new extralocomotor skills, formation of adequate dynamic and static stereotype, normalization of limbs' joints motor functions, improvement of coordination movements.

Patients should receive psychological rehabilitation in order to reduce the level of stress, correct the internal picture of the disease, eliminate anxious or depressive components. Teaching in patients on methods of therapeutic gymnastics and formation of their motivation on an independent daily repeating of exercise complexes should be carried out as well.

Thus, a multidisciplinary approach to medical rehabilitation in patients with dystrophic lesions of the spine contributes to the normalization of their physical, emotional and general state, which improves social activity and functioning, and, as a result, improves the quality of life.

### CONCLUSIONS

1. Today, it is necessary not only to actively introduce existing methods of medical rehabilitation into the practice of physical therapists, but also to create new and more effective rehabilitation programs that require an individual approach to each patient, to work on creation of institutions and rehabilitation centers that would include experienced rehabilitation specialists (multidisciplinary team). This will allow to implement rehabilitation intervention with maximum efficiency.
2. The most common groups of patients seeking help from a physical therapist are patients of the neurological profile, as well as patients with disorders of the musculoskeletal system. Summarizing the data presented, it should be

noted that, fortunately, physical therapy, as an important component of medical rehabilitation, is recently characterized by improvement of its means and methods. An important aspect in modern physical therapy is development of an individual program of rehabilitation intervention, the application of principles of gradual increasing of physical activity, which are systematical and complex.

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Info

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# Modern Approach to Prevention of Chronic Recurrent Aphthous Stomatitis

## Nowoczesne metody zapobiegania przewlekłemu nawrotowemu aftowemu zapaleniu jamy ustnej

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### SUMMARY

**Aim:** To analyse and summarize the data of modern scientific literature for the last 10 years on modern approaches to the prevention of chronic recurrent aphthous stomatitis, etiology, pathogenesis and treatment of this disease.

**Materials and Methods:** Analysis and generalization of data from the modern scientific literature on the etiology, pathogenesis, prevention and treatment of CRAS based on databases such as Scopus, Web of Science, MedLine, PubMed, NCBI, the study of which does not exceed 10 years, including literature reviews and results of clinical trials.

**Conclusions:** The prevention of chronic recurrent aphthous stomatitis requires a comprehensive and individualized approach to solve this issue. Reduction of this disease to one cause becomes serious due to its polyetiology, which makes it more difficult to predict the causes of recurrence and solution of the prevention issue. Trigger mechanisms that provoke the formation of CRAS differ in various patients (stress, mechanical disorders, the nature of nutrition, lack of vitamins or trace elements, infections, etc.). However, the immunopathogenetic mechanism may be a common link for the main triggers of the aphthae recurrence emergence. Due to the imperfect understanding of etiopathogenetic factors, the prevention of chronic recurrent aphthous stomatitis is aimed at increasing the intervals between the appearance of new lesions, reducing the number of aphthae and their size, so in other words, it is secondary.

**Key words:** aphthae, ulcer, RAS, CRAS, etiology

**Słowa kluczowe:** afty, wrzód, RAS, CRAS, etiologia

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### INTRODUCTION

Chronic recurrent aphthous stomatitis (CRAS) is one of the most common diseases among pathologies of the oral mucosa, characterized by the presence of aphthae (ulcers), which recur, mostly without a pattern, and are characterized by a long course and pain [1].

Among the numerous pathogenetic mechanisms of chronic recurrent aphthous stomatitis development, nowadays, autoimmune ones are preferred. That is, CRAS is considered to be a multifactorial T-cell mediated immune dysregulation [2].

Factors that can affect the immune response are genetic predisposition, viral and bacterial infections, allergies, deficiencies of vitamins (B6, B12) and trace elements (zinc, iron), systemic diseases, hormonal disorders, injuries and stress [3].

Despite the diversity of different methods of CRAS treatment, the problem of complete cure of this disease remains open. After all, in most cases it is symptomatic and ineffective, which is largely due to insufficient understanding of the etiopathogenetic factor of the disease. In turn, this increases the relevance of studying the question of precaution of this disease to prevent the emergence of new lesions [4, 5].

Disease of the oral mucosa is the most complex and relevant in the study section of therapeutic dentistry, given the multifactority, the need for a comprehensive approach to diagnosis and treatment, insufficient study of the leading etiopathogenetic mechanisms of formation and progression. A single theory that would explain the role of all known factors in the formation and progression of CRAS has not yet been created. Views on the etiology and pathogenesis of CRAS are changing along with the development of medical

science, expanding the possibilities of functional and laboratory diagnostics.

Therefore, given the violation of the patient's condition during exacerbation, the severity of pain, as well as the high frequency of disease recurrence after treatment, the study of the main mechanisms of CRAS pathogenesis and focus on prevention of this disease is a relevant problem of dental science and practice, which determined the relevance of the research topic.

### AIM

The aim of the study was to analyse and summarize the data of modern scientific literature for the last 10 years on modern approaches to the prevention of chronic recurrent aphthous stomatitis, etiology, pathogenesis and treatment of this disease.

### MATERIALS AND METHODS

Analysis and generalization of data from the modern scientific literature on the etiology, pathogenesis, prevention and treatment of CRAS based on databases such as Scopus, Web of Science, MedLine, PubMed, NCBI, the study of which does not exceed 10 years, including literature reviews and results of clinical trials.

### REVIEW AND DISCUSSION

Prevention of recurrence of chronic recurrent aphthous stomatitis, first of all, lies in elimination of possible provoking factors that force to delve into the analysis of etiopathogenetic links and characteristics of this disease.

Chronic recurrent aphthous stomatitis is a common disease, idiopathic in nature, characterized by the appearance of painful aphthae and frequent recurrence. Aphthae is a lesion of a clearly defined form with a grey fibrinous plaque, surrounded by a corolla of hyperemia, which is observed on the nonkeratinized mucosa. Typical sites of localization are the mucous membranes of the cheeks and lips, the bottom of the oral cavity, the ventral surface of the tongue and the soft palate.

CRAS classification. There are many classifications of chronic recurrent aphthous stomatitis. Classic aphthae and Setton's stomatitis are distinguished; by severity - mild, moderate and severe forms. I. M. Rabinovych (1998) distinguishes the following forms: fibrinous, necrotic, glandular, deforming. The disadvantage of all these classifications is the selection of non-independent forms that are not clinically different from each other. Therefore, the results of clinical observations make it possible to recommend the WHO classification, which distinguishes 3 forms of CRAS existence: minor, major, herpetiform.

Minor aphthous lesion is the most common form of CRAS, with a diameter of less than 1 cm, round or oval lesions with yellow or grey pseudomembranous plaque, surrounded by a corolla of hyperemia. The healing occurs in 7-14 days.

Major aphthous lesions are much deeper and larger (2-3 cm in diameter). They may have irregular raised edges. The healing period is from several weeks to several months, sometimes with the formation of scars. Much less common

is herpetiform CRAS, 1 to 2 mm in diameter, localized in groups from 10 to 100 lesions. The healing period is several weeks [6].

The sequence of the course of the disease includes the following stages: prodromal, characterized by the presence of symptoms, but the absence of visible signs of the disease (heartburn and discomfort, lasts 24 hours); pre-ulcerative, the appearance of mild edema and redness (3 days), ulcerative – the formation of aphthae (1-16 days); healing associated with a reduction in symptoms, a period of epithelialization (4-35 days) and remission in which there are no symptoms or signs of ulceration [7].

Recurrence of the disease is established with the appearance of new aphthae. The severity of the disease can be determined by the number, size, location of ulcers, the presence of pain, duration of the disease, intermission periods [8], and it also affects the quality of life.

The prevalence of the CRAS disease is approximately 20% of the population at large. According to Wang H. et al. [9], this is one of the most common diseases of the mucous membrane of the oral cavity (27.17%). The representatives of the female sex and the wealthy socio-economic class are affected the most. The age of exacerbation of the disease falls on childhood and 2<sup>nd</sup> or 3<sup>rd</sup> decade of life, the number of relapses decreases with the approach of old age. No correlation was found between racial species. Chronic recurrent aphthous stomatitis can be a manifestation of Behcet's syndrome, systemic lupus erythematosus, reactive arthritis and inflammatory bowel diseases, especially Crohn's disease [10].

Patients with CRAS may suffer from anemia, vitamin B12 and folic acid deficiency, so it is considered that the additional use of these substances with food or in medicines reduces the recurrence of CRAS. Kozlak et al. surveyed 100 patients regarding their diet, which included the frequency and general consumption of 124 articles of food over the last 365 days. The results suggested that CRAS could only be a clinical manifestation of vitamin B12 and folic acid deficiency [11]. The meta-analysis by Chen H. et al. found that anemia or deficiency of vitamin B12 and folic acid is an important factor of CRAS. Usually, the diet should not be limited to the use of these micronutrients, but also other elements that promote hematopoiesis [12].

According to some studies, the consumption of such products, which contain chocolate, gluten, cow's milk, preservatives, dyes, nuts, can cause a pro-inflammatory cascade of cytokine secretion in CRAS. However, in 2012, a group of scientists [13] denied this information in their study and stated that the patient's eating habits do not affect the development of CRAS, and may serve only a minor purpose in the pathogenesis associated with hypersensitivity or deficiency of vitamins and minerals.

Quite a common theory of CRAS emergence is the peculiarities of the composition and interaction of the microflora of the oral cavity. A recent study on this topic [14] suggested that the prevalence of CRAS may be closely related to an increase in *Escherichia coli* and *Alloprevotell*, and a decrease in *Streptococcus*. Given that *Escherichia coli* is a

common intestinal bacterium, it has been suggested that colonization of *E. coli* may cause CRAS, and its control may facilitate treatment and prevention of the disease.

Stress is considered to be a major trigger component of many diseases, including CRAS. It leads to metabolic and hormonal changes, including an increase in cortisol level in the blood. Stress can cause changes in human behaviour, such as injury, biting the lips, dry mouth, which provokes lesions. A significant increase in the concentration of cortisol in the oral fluid and blood of patients has been found, so the effect of stress on the recurrence of CRAS is quite justified. A recent study [15] determining the mean level of cortisol in saliva and DHEA confirmed a significant increase in these values in patients with CRAS compared with the control group. The authors in this study suggested using the level of cortisol in saliva and DHEA as CRAS biomarkers. This hypothesis requires further study with a larger sample of the examined and an improved protocol. But there is no doubt in the main methods of CRAS prevention, which are the prevention of stress factors and medical support for such conditions.

Insufficient sleep or its irregularity can cause or worsen the course of CRAS, which was found in college students, that is associated with a violation of the daily cycles of growth hormone and cortisol secretion [16]. Impaired lifestyle (malnutrition, lack of sleep, stress) leads to the emergence of new lesions, an increase in their number and size in patients with CRAS, so general practitioners should recommend a healthy lifestyle before prescribing drugs [17].

The relationship between oxidative stress and CRAS has been described in many studies. One of them determined the increase of oxidative status and stress in patients compared to healthy patients and the absence of differences in antioxidant status in two groups, respectively, which may indicate the influence of these factors on the pathogenesis of the disease [18].

One of the oldest points of view, dating back to the mid-1960s, was described as the influence of genetic predisposition on the development of CRAS. Approximately 40% of patients with CRAS have a family history, but heredity may be a polygenic trait, the penetrance of which depends on other factors. Studies conducted by Chen and Wu have shown that the presence of an IL-1 $\beta$ +3954C/T interleukin family gene polymorphism is a risk factor for CRAS [19, 20].

The 308 G/A polymorphism of the TNF- $\alpha$  gene, which encodes the expression of the anti-inflammatory cytokine TNF- $\alpha$ , has pathogenetic significance in the development of CRAS. Polymorphism 308 G/A rs1800629 of the TNF- $\alpha$  gene, the carrier of allele A and homozygous genotype G/A can be considered as factors indicating a hereditary predisposition to CRAS and criteria for the severity of the clinical course [21].

The immunopathogenetic mechanism may be a common link for the main triggers for the recurrence of aphthae emergence: stress, trauma, chemical stimuli, gastrointestinal disorders, nutrition peculiarities, oral cavity microflora [22].

One of the main immunological criteria with the help of which you can determine the type of immune response in the human body is cytokines. The Th1 type of cytokines includes IL-2, IL-12, IFN- $\gamma$ , TNF- $\alpha$  and indicates a tendency

to autoimmunization, increases the cell-mediated immune response, and stimulates the secretion of IgG. Type Th2 - IL-4, IL-5, IL-10, IL-13, exhibits anti-inflammatory properties, stimulates the humoral immune response and the production of IgE. It has been studied that aphthae occur due to an enhanced immune response against certain areas of the mucous membrane of the oral cavity. This process occurs as a result of an incorrectly initiated cascade of cytokines, which initiates a certain immune process.

In both types of the immune response: natural or acquired (cellular, humoral) we can observe CRAS disruptions, manifested by revitalization and hyperactivity of neutrophils, increased concentration of complement components, increased number of NK and B-lymphocytes, violation of CD4+/CD8+ index, increase in CD25+ and T-cell receptor  $\gamma\beta$  in peripheral blood [23].

Very often not only cellular immunity is disrupted at CRAS, but also in combination with the humoral one. It was investigated that IgG, IgA, IgE, C3, C4 are significantly increased in the peripheral blood of patients, compared with healthy ones. The percentage of CD4+ and B-lymphocytes was reduced, while CD8+ and NK were visibly elevated. There was also a correlation between the frequency of violations of IgG or IgE with CD8+. The relationship between two immunities may be an important immunological aspect involved in the pathogenesis of CRAS [24].

Changes in the regulation of T-cells are involved both in the development of CRAS and Behcet's disease. The main factors influencing the violation of the regulatory mechanism are changes in the functioning of CD4+CD25+ Treg cells, abnormal variations of Toll-like receptors, disruption of the cytokine cascade and the production of immunomodulatory enzyme – Indoleamine2,3-dioxygenase (IDO). The decrease in IDO leads to impaired immune tolerance of the mucous membrane in patients with CRAS. ShRNA-based IDO suppression is effective in the treatment of cancer and may be involved in the treatment of immune-mediated diseases. The miRNA profile in Treg cells has antiproliferative and apoptotic activity to inhibit T-cells, suggesting its valuable therapeutic potential at aphthous lesions to prevent recurrences, which is a common problem for both patients and clinicians [25].

Given the presence of an imbalance in the immune system, it is reasonable to include immunocorrective drugs in the treatment such as Decaris, Galavit, etc [26]. Kaya et al. [27] investigated that Levamisole, which is one of the first representatives of a potentially new class of immunologically active compounds, regulates cell-mediated immune responses by restoring the effector functions of peripheral T-lymphocytes, phagocytes, and stimulating precursor T-lymphocytes to differentiate into mature cells.

There is a dissenting opinion about the effectiveness of this drug [28]. This is due to the fact that small doses have an immunostimulatory effect, and large doses act as immunosuppressants.

Studies conducted by Tecco et al. found that in children aged 5-10 years, the presence of destroyed teeth is associated with the existence of minor lesions of chronic recurrent aphthous stomatitis [29].

Prevention of CRAS includes full mouth debridement, treatment of periodontal disease, adequate prosthetics, treatment of the ENT organs and gastrointestinal tract diseases in order to eliminate chronic foci of inflammation. People with hypersensitivity to medicinal and household allergens should use hygiene products, sulfonamides and antibiotics carefully and cautiously. Patients prone to CRAS should limit severe mental and physical stress, as well as hypothermia.

## CONCLUSIONS

Taking into account all the above-mentioned facts, it can be seen that the prevention of chronic recurrent aphthous stomatitis requires a comprehensive and individualized approach to solve this issue. Reduction of this disease to one cause becomes serious due to its polyetiology, which makes it more difficult to predict the causes of recurrence and solution of the prevention issue. Trigger mechanisms that provoke the formation of CRAS differ in various patients (stress, mechanical disorders, the nature of nutrition, lack of vitamins or trace elements, infections, etc.). However, the immunopathogenetic mechanism may be a common link for the main triggers of the aphthae recurrence emergence.

Therefore, having analysed all the above-mentioned facts, we can summarize modern approaches to the prevention of CRAS, which include: full mouth debridement, treatment of periodontal disease, adequate prosthetics, elimination of chronic foci of inflammation, the limit of severe mental and physical stress, hypothermia, people with hypersensitivity to drugs and other allergens should limit contacts with them, leading a healthy lifestyle, rational nutrition, good quality sleep, additional intake of vitamin B12 and folic acid as well as other micronutrients.

Mainly due to the imperfect understanding of the etiopathogenetic factors of CRAS, the prevention of chronic recurrent aphthous stomatitis is aimed at increasing the intervals between the emergence of new lesions, reducing the number of aphthae and their size, so in other words, it is secondary.

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# Interactive Cases of Bioethics and Public Health: by the Examples of Counteraction to Xenophobia, Discrimination and Inequality

## Interaktywne zagadnienia z bioetyki i zdrowia publicznego na przykładach przeciwdziałania ksenofobii, dyskryminacji i nierówności

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### SUMMARY

**Aim:** This article examines how bioethicists can make a significant contribution to mediation, public discourse, research, educating, learning, policy-making and academic impact in response to troubling and persistent models of xenophobia, racism and 'pretentious' prejudice. In order to make a meaningful contribution to these issues, bioethicists need training, awareness that they can play an important educational role in cooperation with other specialists and social spheres.

**Materials and Methods:** An understanding of these issues from the perspective of bioethics is important in terms of the methodological approach that is used in its explanations. For example, in education, public health, etc. In the course of the research the bibliographic, biblíosemantic method, the method of system analysis.

**Conclusions:** The main mechanism for combating xenophobia is the development of personal and social tolerance. Tolerance does not require an obligatory love to «our own» and to «others», but offers recognition of the real pluralism of cultures and ways of life, Professional training of/for bioethicists as partners/trainers who work together with the community to create solutions. Thus, as bioethicists, we create new educational and cultural programmes based on the knowledge gained through the integration of previous projects in various layers of society. They stimulate ethical and creative thinking, create conditions for team learning and encourage people in teams to find innovative ways of operating in contexts of high uncertainty and complexity of the 21st century. We therefore assume that bioethicists, as agents of change, are able to operate on various educational levels (starting from the primary level), contributing to increasing awareness and tolerance of one country's population by communicating key bioethical messages. The purpose of bioethicists as educational tutors will be not only to understand the social and psychological sources of xenophobia and discrimination manifestations, but also to corroborate existing negative attitudes and stereotypes prevalent in the modern society.

**Key words:** bioethicist, xenophobia, antisemitism, discrimination, cases and bioethical tools

**Słowa kluczowe:** bioetyk, ksenofobia, antysemityzm, dyskryminacja, przypadki i narzędzia bioetyczne

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### INTRODUCTION

Sociologists and sociological surveys [1-4] confirm that the level of xenophobia in Ukraine tends to grow. Our country does not differ much from European countries in this regard. In particular, the European Commission against Racism and Intolerance (ECRI) published an opinion which we fully subscribe to: «In many countries, ECRI observes that the elaborate development of strategies and extensive central-level consultations have not always been translated into tangible results on the ground [5]». Why have strategies of taking down xenophobia and racially-motivated violence, implemented at the highest levels, often failed to meet the expected results? In the world, as well as in Ukraine, the implementation of

strategies to address these socially unacceptable phenomena seem to be only declarative. In Ukraine, we can witness an active xenophobic attitude, an atmosphere of intolerance towards «Others», «Aliens», because this is also mostly connected with the social and political processes happening inside of the country and in the whole world.

It should be noted that the need for development of a new ethical concept of coexistence, different moral practices and a corresponding ethical doctrine of moral relevance became unavoidable. An important component of this concept, in our view, is the concept of the difference in moral stance depending on the degree of social distance. This concept must inevitably be based on the analysis of the concepts

of the «Other» that can be traced in ethical thought from Martin Buber through Hannah Arendt and Emanuel Levinas to Charles Taylor and Alasdair McIntyre.

Our position relies on the fact that the moral decision should not be so much determined by the social structure, as by the way we participate in this structure and possibly change it on the grounds of counter factuality [6]. All other more socially distant ethical relationships must be built on relationships with others, as a foundation, without such a foundation they will be too thin and not only unreliable, but above all, unpractical and, for the most part, inevitably tend towards declarativeness. After all, it is our relations with our next of kin that are most regular and that must be judged most ethically strictly – on their basis we build our habits which, «having sown them, we reap character» and ultimately form our virtues. Further contractual relations (including moral-conventional relations) and post-conventional relations, i.e. universal moral maxims, can be developed on this ground.

### AIM

This article examines how bioethicists can make a significant contribution to mediation, public discourse, research, educating, learning, policy-making and academic impact in response to troubling and persistent models of xenophobia, racism and 'pretentious' prejudice. In order to make a meaningful contribution to these issues, bioethicists need training, awareness that they can play an important educational role in cooperation with other specialists and social spheres.

### MATERIALS AND METHODS

#### DATA. IDENTIFICATION OF THE GENERAL LEVEL OF XENOPHOBIA IN UKRAINE

Using the data received by domestic researchers with the assistance of international law-enforcement organizations, it should be noted that the level of xenophobia in Ukraine has increased by several fluctuations: From 1994 to 2007, it increased from 3.5 to 4.3 points; from 2008 to 2013 the index decreased to 4.0 points, but in November 2019 it rose again to 5.41 points (researchers connect this tendency with the annexation of the Crimea and the military conflict in Donbas)(we refer to the measurement according to the Bogardus social distance scale). The problem of xenophobia against both – representatives of other countries and some Ukrainians, who are subjectively part of the "alien" group becomes particularly acute [7].

A sociological study was conducted in 2019 by the Kyiv International Institute of Sociology. As a result of data processing, Ukraine has the lowest social distance to Ukrainian-speaking and Russian-speaking Ukrainians (index 2.2 and 2.7, respectively). Respondents were thus willing to accept the representatives of these groups as members of their families and close friends. Next in the social distance were Belarusians (3.2) and Russians (3.6), followed by Poles, Jews, Crimean Tatars, Canadians, Americans and Germans. In these groups, the indicator of social distance is approximately

the same – 4.1-4.3. The French (4.4), Romanians (4.7) and Africans (5.2) round out the social distance hierarchy. The greatest social distance in Ukrainian society is observed for the Roma ethnic group (5.4) [8].

In order to create a clearer picture of the causes of hostile and intolerant behavior among different groups of the Ukrainian population, we also used a degree scale of xenophobic attitudes expression [9]. The use of the analytical approach and bioethical tools applied to the survey conducted by Ukrainian sociologists allow to make certain assumptions about the factors that have the greatest impact on the level of anti-Semitism and xenophobia.

#### FACTORS AFFECTING THE LEVEL OF ANTI-SEMITISM AND XENOPHOBIA

The general level of xenophobia and the level of anti-Semitism are inherently dependent on the level of education – the higher is the level of education, the lower is the level of xenophobia and anti-Semitism.

The level of anti-Semitism depends on the type of locality: in the city it is lower than in the village, and the level of anti-Semitism drops with the escalation of the city (V. Paniotto) [10].

The age dependance of xenophobia. V. Paniotto found out that there is a correlation between the attitude to people of «different» ethnic groups and the age of the respondents. While the xenophobia index was 3.7 among 18–20-year-olds, the index was 4.1 among people over 70.

The gender dependance. It is no coincident that, in the scientific works of Balibar and Wallerstein [11] racism is discussed alongside with sexism. Scientists have shown that the possibility of the exploitation of «colored» men in the countries of the former Third World is based on the unenumerated (and unmeasured) female labour. Male workers are able to maintain their ability to work because «there is a female worker on hand to work the field that the male worker is feeding on».

Influence of configuration of power. Power associated with the right to name, to give names (Pierre Bourdieu describes this phenomenon as a «monopoly on nomination» [12]). In power is the one who does the naming, and the subordinate is the one who is being named. It is worth underlining the lack of symmetry between the racism of the subordinates and the racism of the ruling; the subordinates exist in a clear no-win position, since their counterparts are being supported by a system of relations crystallized through the centuries.

The influence of art on the perception of social inequalities. Individuals' self-assessment of their position in the public space. Art has a universal language. It is true because the dialogue involves communication and interpretation of understanding, context, creative intuition and intentions, including moral ones. The tolerance of art allows the him/ the dialogue to take in the previous experience not only of their own culture but also the experience of other culture's worldview, this contributes to the harmonization of human relations, the development of intercultural dialogue, the search for an ethno-confessional consensus and the forging of new

approaches to resolving discrimination and racism. We have identified this factor as a valuable element in our reflection on this article.

## REVIEW

### THE PATH OF CHANGE: CASES AND BIOETHICAL TOOLS

Why is it important to start with education? What is the impact of bioethicists in the medical field and in everyday life? The main task of the bioethicist in this research perspective is 1) to change the focus on (bio)ethical analysis, paying more attention to social determinants of health and the impact of racism on human health and social well-being; 2) Offer resolution tools to reduce anti-Semitism and xenophobia. Thus, we propose that through the above-described factors, affecting the level of anti-Semitism and xenophobia, to describe the cases and bioethical instruments to address them:

The general level of xenophobia and the level of anti-Semitism are strictly dependent on the level of education – the higher the level of education, the lower the level of xenophobia and anti-Semitism

**Case:** Project Implicit by Lester Darryl Geneviève, Andrea Martani, David Shaw, Bernice Simone Elger & Tenzin Wangmo is exactly about improving education in the health sector. The authors of the Project Implicit see the improvement of primary care education in the increased focus on understanding the impact of stigma in the field of medicine. It is important not only to increase the number of minority representatives as physicians, researchers and other health professionals, but also to engage these practitioners to see their routine clinical work in a new light when dealing with stigmatized people. A practical option for assessing the degree of implicit racial superiority of minority groups is the Project Implicit Association Test, which aims to educate the population about implicit racial superiority. Project Implicit data have already been used to show how racial bias negatively impacts black women's fertility outcomes in the United States, or even the prevalence of implicit bias against LGBT people. These tests can help clinicians better identify and then challenge appropriate treatment choices for members of minority groups [13].

**Tool:** The case study by Project Implicit has brought into light the impact of education in the medical field and is a truly practical case study. In the table below we would like to present the tools used by the authors of this article by bioethicists in Ukraine in transdisciplinary projects in formal and non-formal education (Table 1).

The level of antisemitism depends on the type of settlement: in a city it is lower than in a village, and the level of antisemitism drops with the size of the city (V. Paniotto)

**Case:** One of the areas of research on social determinants, studied by scientists, is the actual location of the population, namely access to health care in rural areas and its quality level [14] state, an almost 400 million indigenous people around the world have poor health. Poor health is related to poverty, malnutrition, poor hygiene, environmental pollution and widespread infections. Lack of clinical support for health improvement and poor disease prevention make

the situation worse. Some indigenous groups, moving from traditional to transitional and modern lifestyles, quickly develop lifestyle-related diseases such as obesity, cardiovascular disease and type 2 diabetes, as well as physical, social and mental health problems associated with alcohol and drug use [15].

**Tool:** Addressing these injustices requires increased awareness, political acceptance and recognition, rather than exclusion, of these serious and complex issues. Indigenous people need to be encouraged, trained and empowered to get more involved in solving these problems.

In Ukraine, one of the tools of a bioethicist in the context of reducing the level of discrimination in small communities may become the involvement of local community leaders into cooperation and dialogue. These communities are gaining more and more autonomy now, in accordance with the law on decentralization. In this context, beneficial could be not only educational activities but also the experience of cooperation between community leaders and representatives of community organizations that strive to solve community problems. Thanks to the "Access to Medicine" programme, people in rural areas have begun to receive access to medical care. This has a positive impact on the level of trust in the community leader, the outpatient clinic doctor, who (in their turn) are agents for change, conveying to the community the ideas of openness, tolerance, gender equality, cooperation and friendship.

## DISCUSSION

### THE DEPENDENCE OF XENOPHOBIA ON AGE

**Case:** A 22-year-old Crimean Tatar girl who graduated from the medical university in Vinnytsia was upset by the employer's rejection. The main arguments of the head of the regional hospital department were her young age, lack of experience in the field and, at the same time, the assertion that she (as a Muslim) would marry very soon and have a child. The employer will thus be forced to look for another employee to take the place of the woman going on maternity leave. Assurance and reassurance of the young woman that in spite of her age and nationality she wasn't going neither to get married, nor much less to go on maternity leave for the next few years, did not have an impact on the employer [16].

**Tool:** Influence through community organizations, representatives of the authorities and representatives of employers: meetings and discussions on the topic of discrimination and genderism. These social campaigns aim to dispel the stereotype that age matters and that young people are incapable of generating new ideas, starting up their own business and acquiring new skills. The project includes a summer internship programme, a series of motivational stories and expert interviews with collaborators, opinion leaders and ordinary Ukrainians who have changed their lives at a respectable age. Despite the positive shifts in this issue, we must note the unwillingness of the media to speak broadly about issues of discrimination and intolerance. Sometimes, even the representatives of some TV companies or news websites keep on using the language of hate ascribing certain

**Table 1.** Bioethical tools in transdisciplinary projects in formal and non-formal education

| Influence area           | Bioethicists tools   |
|--------------------------|--|
| <b>Schooling</b>         | <p><b>Advanced training of teachers.</b><br/>Through the activities of the Bioethics NGO, which is headed by one of the authors of this article, we joined EDCamp Ukraine (EDCamp Ukraine is a unique independent educational movement for the professional development of teachers in Ukraine).<br/>Two years in a row (2018, 2019), were held educational meetings with the expert community of Ukraine and Germany in the field of teaching in the process of this cooperation. In the meetings we used teaching methods and trainings against bullying and discrimination. A total of more than 400 people were involved in the event: teachers, the expert community of formal and informal education, and non-governmental organizations.</p> <p>MAIN TASKS OF THIS ACTIVITY: education, anti-discriminatory educational initiative; possibility of participation in state reforms, formation of public opinion in the values of respect and integrity, partnership, gender equality and non-discrimination, inclusion; Organizing regional (un)conferences for educators and local communities, supporting the organization and implementation of professional development programs, master classes, training programs, exhibitions, competitions, etc.<br/>Creation of original training module for schools through the support of the Tolerance Space Education Center in the project «Validation Controversies. Continuation» in partnership with CRISP Conflict Simulation and Auswärtiges Amt (Ministry of foreign affairs). A total of 23 modules will be created and tested in the project.</p> <p>OBJECTIVE OF THE PROJECT: To acquaint the educators/youth with interactive resources for working with historical subjects (the role of the bioethicist in this module sides with historical subjects of bioethical dilemmas), to provide techniques for creating educational modules on the basis of these tools and jointly develop an approach that can be used by other teachers.<br/>The project will culminate in a set of finalized teaching modules for in-service use; the creation of mini-projects designed and implemented with the students</p> |
| <b>Higher education</b>  | <p>Signature training programme for public health students, „Bioethical aspects of public health strategies“ (Department of Public Health of the Medical Institute (Sumy State University (SSU)), Sumy, Ukraine).</p> <p>Programmes of the National University of Health Protection of Ukraine named after P.L. Shupyk. «Humanitarian Basis of the Physician`s Activity»; «Bioethical and Ethical-Deontological Basis of the Physician`s Activity» for medical-interns; «Humanitarian Aspects of Clinical Thinking of a Physician» for physicians with practical experience in the sphere of health care.</p> <p>MAIN OBJECTIVES OF THE ACTIVITY: Humanization of medical activity, implementation of modern bioethical principles and principles of the Ukrainian Ethical Code in medical theory and practice; involvement of physicians of various specialties to trainings, symposiums, round tables on topics of non-discrimination, equality and respect. Typically, over 300 doctors and scientists are trained in these educational programmes.<br/>An independent ethics committee at the National University of Ukraine for Health Protection.<br/>MAIN TASKS OF ACTIVITY: Fostering the integration of ethical, bioethical and moral principles and values into biomedical, clinical and other scientific research and scientific articles, which are submitted for publication in scientific journals as a result of these studies, by conducting an independent ethical expertise. Protection of the rights, welfare, safety and integrity of the research subjects. Control over observance by the investigator of ethical and bioethical principles and values, legal requirements for the various types of research</p>   |
| <b>Expert activities</b> | <p>Independent Commission on Ethics at the National University of Ukraine for Health Protection.</p> <p>THE MAIN OBJECTIVES OF ITS ACTIVITIES: promotion and integration of ethical, bioethical and moral principles and values into biomedical, clinical and other scientific research and scientific articles, which are submitted for publication in scientific journals as a result of these studies, by conducting an independent ethical expertise. Protection of the rights, welfare, safety and integrity of the research objects. Observance control of the investigator following the ethical and bioethical principles and values, legal requirements for the various types of research</p>   |

stereotypically related characteristics to representatives of the whole ethnoses.

The aim of the future evaluation is to build cooperation between bioethicists and the media, and to participate in various projects, shows and programmes to break stereotypes about the “other”, forming a positive public opinion on the possibility of merging of different social identities within a single society. Such interaction must be based on moral and bioethical values and rules.

#### LEVEL OF ANTI-SEMITISM AND XENOPHOBIA DEPENDING ON THE GENDER

**Case:** Valentina was 27 years old, married and the mother of one child. She had completed higher economic and financial education and was given a job at Nadra Bank. When she was hired, there were two similar vacancies in the organization and she and a man were hired to fill them. Despite a perfect work record, she later discovered that her male colleague had been paid a higher salary than her, despite their positions

being similar. When she challenged the bank's director, she was told that «men took no maternity leave» and so the higher salary was a «bonus for riskless behavior». A few months later she left her position [16].

**Tool:** Programmes on gender equality, change of stereotypes. Increased amount of research topics in universities and grant programmes. One of the best tools for the bioethicist was found in the Race, Bioethics, and Public Health Project (Yale Interdisciplinary Center for Bioethics (2020)): The “Race, Bioethics, and Public Health” project aims to provide an online resource library for students, researchers, practitioners, and other members of the community working at the intersection of bioethics, public health, and racial justice. The online archive offers a representative sample of scholarly and popular literature not commonly included in traditional bioethics curricula. By centering the perspectives of communities most impacted by structures of domination, the “Race, Bioethics, and Public Health” project draws primarily from the fields of Black feminism, Africana studies, decolonial thought, queer of color critique, and critical ethnic studies. Readings examine topics ranging from reproductive justice, clinical ethics, and access to health care to environmental justice, biopolitics, artificial intelligence and other medical technologies.

Social inequality shapes imbalances in health while racism and discrimination leave marks on the experience of people around the world, and inequality is being absorbed and inherited. Bioethicists point out that quite often racist, genderist and patriarchal ideologies can be the basis of medicine, science and technology.

In analyzing this tool, it should be noted that efforts to address inequality must be made through collaboration between different elements of society, mediated by bioethicist tutors. By making intolerance, discrimination and racism visible and negotiable, we aim to break these negative connotations of multiple societal inequality deeply rooted in historical, political and structural contexts.

#### THE IMPACT OF THE CONFIGURATION OF POWER

**Case:** Official institutions in Ukraine, especially medical and academic ones, tend to be very hierarchical. The attempts to build capacity in the field of bioethics within these hierarchical structures display a number of challenges. For example, even if a practitioner has obtained a bioethics qualification at a prestigious western university, it does not mean that he or she will be accepted on a full-time basis at his or her home institution. Especially if he or she has not yet received a doctoral degree (status in Ukraine also has a hierarchical stigma). Experienced professors may object to being «taught by younger people», even if (or especially if) the latter is generally more knowledgeable in the field. Also, one of the «pain points» of the potential conflict in this case is the development of training programmes. In designing new educational courses or programmes, the involvement of experienced local trainers is essential. However, these local trainers, more often than not, are not familiar with bioethics and the very idea of teaching older teachers can be politically sensitive. The very nature of bioethics causes friction and

opposition in power structures. In Ukraine we often expect that senior teachers and professors in hierarchically structured educational institutions will always know the «right answer». They will therefore choose “comfortable” topics of instruction rather than those that might cause confusion and fear in the population and raise doubts about their status.

**Tool:** *InPlatBio* is an integrative bioethics platform with online and offline forms. *InPlatBio* Integrative Bioethics Platform [17;18] <sup>1</sup> is a structure that integrates knowledge on all aspects of bioethics / bioethics knowledge integration platform, which considers openness of scientific information to the general public. Examples of offline platforms in/for any field are training of bioethicists (courses, trainings, exchange of experience). The main idea of our online platform *InplatBio* is to highlight scientific, social and political solutions to ethical issues in today's world (these could be ethical codes, bioethical standards, civic participation projects, art initiatives, and so on).

Hence using *InplatBio*: (1) We have started and will continue to listen directly (via interviews) to our communities (currently, in the education sector) in order to understand their experiences on racism, discrimination and bioethics. (2) We suggest the creation of an interdisciplinary group to work on improving understanding of racism, discrimination and possible reactions. (3) We will initiate a review of training plans and programs, and (4) we will develop and share a plan of how to improve and promote the most effective anti-racism response at *InPlatBio*. We believe that it is crucial to educate experienced trainers in Ukraine for building institutional capacity in the field of bioethics and reducing hierarchical influence. Accordingly, there may be an impact on anti-discriminatory programmes. The influence of art on the perception of social nerves. Individuals' self-appraisal of their own position in the public space.

**Case:** How many people know about the art of dark-skinned people in Ukraine, or about the art of people with disabilities? This amount of people is close to zero. The inclusive artistic project «Chimaera We Exist» is a transdisciplinary project that combines the work of people with disabilities in theatre with a director, the work of a bioethicist on social inclusion and the work of an urban artist (who works on Mural in the project, together with the artist).

**Tool:** in the context of this case, we work with the methodology of *urban bioethics*. The term «urban», as opposed to other fields of biology, does not denote its distinct theoretical perspective [19]. Allowing the transfer of bioethics methods to the public sphere, where questions/discourses/dilemmas of ethical nature enrich the awareness of the citizen (without being dominated by it) [20]. In the opinion of Jeffrey Blustein, *urban bioethics* can be compared to clinical bioethics, we can understand it as we understand clinical bioethics – activity/practice using established ethical principles or solving practical problems that arise in the clinical sphere. Thus, the urban realm provides the same normative guidance for problems arising in the urban realm [21]. The participants have the opportunity to engage with the problems of inclusiveness through the structuring of actors as well as to investigate

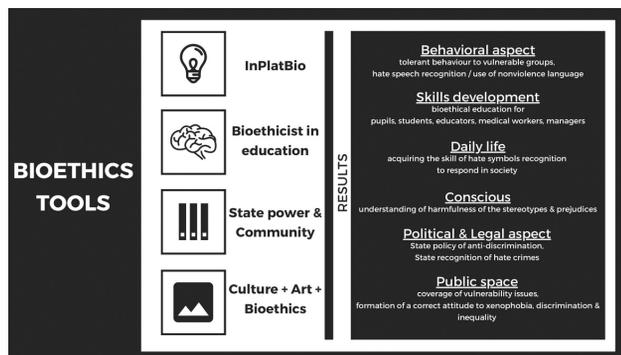


Figure 1. Bioethics tools

their own city and to improve it - to create their own unique place in the city – to work on the image of a Mural.

The cases we have described do not have a residual solution. Sometimes, as in life, they shuffle like cards in a «deck of multiple discriminations». But we have tried to find and to show you the optimal solution, which we thought through together in this article (which can have several effective solutions in different situations, cultures and factors). Of course, cases can constantly change because they are based on real facts, have real-life situations, and, therefore, we perceive them as a life-changing process. Our task now is to define a bioethical methodology for studying racism and xenophobia, which would enable us to systematize the information gathered through various indicators into a comprehensive algorithm for examining the state of inequalities in modern societies, particularly in the Ukrainian one. (Figure 1). In the picture we have gathered bioethical tools of change and results of implementation.

## CONCLUSIONS

We wanted to emphasize the importance of moving beyond mere descriptions and definitions of problems regarding racial inferiority of groups and to move towards an unmediated inclusion and transformation/immersion of basic norms, values and practices of bioethics into the problematics of racism. The physical and psychological consequences of racial discrimination: stress, anxiety, depression, hypertonia are reactions mediated through neurobiological mechanisms [22]. Bioethicists can gather feedback from the fields of medicine, public health, students and so on to engage young people in dialogue (survivors of violence and those seeking their own path) in order to highlight these negative health impacts and behavioral changes [23].

The main mechanism for combating xenophobia is the development of personal and social tolerance. Tolerance does not require an obligatory love to «our own» and to «others», but offers recognition of the real pluralism of cultures and ways of life, which is a condition for peaceful co-existence through the proposed tools to reduce racism: education; deeper acquaintance with the culture, traditions of other people, ethnic groups, etc.; collection of empirical data to deepen the understanding of racism; Professional training of/for bioethicists as partners/trainers who work together with the community to create solutions.

Bioethicists, as agents of change, have the capacity to work at different levels of education (starting at the primary level), contributing to increasing awareness and tolerance of the population in the country by communicating key bioethical messages (see the example of the Tolerance Spaces project in this article). The purpose of bioethicists as educational tutors is not only to understand the social and psychological sources of manifestations of xenophobia and discrimination, but also to corroborate existing negative attitudes and stereotypes prevalent in the modern society.

Thus, as bioethicists, we create new educational and cultural programmes based on the knowledge gained through the integration of previous projects in various layers of society. These projects are implemented based on the principles of inclusiveness, transdisciplinarity and integrativeness. They stimulate ethical and creative thinking, create conditions for team learning and encourage people in teams to find innovative ways of operating in contexts of high uncertainty and complexity of the 21st century. This is now an active characteristic of modernity and a field of professional realization. It is our informed choice/perception that this context is our everyday/routine reality and the field of professional implementation/activity.

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# International Balneology and Physical Medicine Conference «Challenges and Prospects of Public Health and Physical Medicine Development»

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## DETERMINATION OF COMPLIANCE FOR THE PREVENTION OF ISCHEMIC HEART DISEASE IN PATIENTS WITH DEPRESSIVE DISORDERS

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**Introduction:** The presence of several diseases in people with depressive disorders worsens their quality of life, increases the number of necessary medications, which can negatively affect the commitment to modify risk factors for coronary heart disease, as one of the causes of disability and mortality.

Factors such as high systolic blood pressure and overweight, high cholesterol, carbohydrate metabolism, and heart failure are the major contributors to mortality from coronary heart disease and cerebrovascular disease.

**Aim:** To study the commitment to the prevention of coronary heart disease in patients with depressive disorders.

**Materials and Methods:** Awareness of risk factors and adherence to secondary prevention of coronary heart disease was assessed on the basis of questionnaires. 33 respondents took part in the survey – 24 men (72.72%) and 9 women (27.28%), average age –  $61.8 \pm 8.7$  years. The period after treatment for depressive disorder was  $2.5 \pm 1.6$  years (from 0.5 to 6.0 years).

**Results:** In order to clarify patients' awareness of how to reduce the risk of myocardial infarction, in the context of prevention of malnutrition, the following possible response options were analyzed: reduction of fat intake, regular consumption of fruits and vegetables.

According to the survey, 21.21% of patients (7 people) are aware that reducing fat intake reduces the risk of coronary heart disease. Among the respondents were men – 12.5% (3 people), women – 44.44% (4 people) ( $\chi^2=1.41$ ;  $p=0.24$ ). It was found that only 15.15% (5 people) said that they reduce the consumption of fats to prevent heart disease. Among the supporters were men – 8.3% (2 people), women – 33.33% (3 people) ( $\chi^2=0.03$ ;  $p=0.76$ ).

Among the study participants, 27.27% (9 people) were aware that regular consumption of vegetables and fruits reduces the risk of cardiovascular disease. Among those informed were men – 15.15% (5 people), women – 44.44% (4 people) ( $\chi^2=0.19$ ;  $p=0.51$ ). However, only 12.12% (4 people) said that they regularly eat vegetables and fruits to prevent heart disease. Among the supporters were men – 9.09% (3 people), women – 11.11% (1 person) ( $\chi^2=0.15$ ;  $p=0.71$ ).

It should be noted that 90.9% of patients (30 people) were recommended by a doctor or physical therapist to follow a diet (eat less sweet, fatty foods). 87.87% (29 patients) answered "Yes" to the question "Do you use any methods to prevent cardiovascular disease, ie do you do anything to reduce the risk of developing or worsening heart disease?" – 91.6% among men (22 people) and 77.78% among women (7 people).

**Conclusions:** Low awareness and commitment to the prevention of malnutrition as a risk factor for coronary heart disease in people undergoing treatment for depressive disorder were detected. Although more than 90% of patients indicate that they have received appropriate recommendations from a doctor or physical therapist.

Further long-term research plans include the study of compliance with the prevention of coronary heart disease in individuals who have no history of depressive disorders. The data obtained will make it possible to determine the impact of the transferred index event on compliance with non-drug prophylaxis.

**Key words:** preventive medicine, depression, coronary heart disease

# VACCINATION ANALYSIS OF THE POPULATION OF SUMY REGION UKRAINE AGAINST COVID-19

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**Introduction:** The main danger of the new strain of Coronavirus infection called "Delta" is rapidly spread between people. The strain "Delta" actively multiplies thousand times more, than the primary strain of coronavirus. The progress of the illness caused by the new strain quickly progresses from mild to severe forms. Children, adolescents and young adults up to 35 years of age are becoming affected by the disease. The clinic of the disease has changed. If earlier the disease had an acute onset, now it is disguised as acute respiratory disease (rhinitis, throat pain, headache, severe aches in the body), the signs will be followed by abdominal syndrome. Later Fever will appear, acute reduce of oxygen saturation, so the disease becomes more complicated. Most often the disease is complicated when it is observed in high-risk patients (diabetes mellitus, arterial hypertension, chronic obstructive pulmonary disease and other). There is an increase in the number of patients with severe disease form that require being treated in hospitals. Lethality, unfortunately, remains at a very high level.

The protection against the new strain of coronavirus infection "Delta" (the disease and its severe form that lead to patients hospitalization, intensive care and fatal cases) is possible by vaccination.

Nowadays, herd immunity is acquired mainly by natural means, which lead to overstraining the medical system, recording higher levels of mortality and hospitalization, reducing the life expectancy of the region's population.

**Aim:** To analyze the state of vaccination against COVID-19 of the population of Sumy region Ukraine.

**Materials and Methods:** Materials of the "Sumy Regional Centre for Disease prevention and control, Ministry of Health and Social Protection", the anamnestic data of the case reports of treated patients at the SRC «Medical Clinical Centre for Infectious Diseases and Dermatology named Z. I. Krasovitsky».

**Results:** As of 15 October, in Sumy region 360,769 people have received the first dose of the vaccine against COVID-19, 253,729 have completed the vaccination course. 13.8% of those who received two doses of the vaccine were vaccinated with Astra Zeneca, 38.4% – Pfizer-BioNTech, 36.5% – Sinovac Biotech, 11.3% – Moderna. The age distribution is dominated by young people aged 20-39. The vulnerable part, those aged 70-79 and 80 years and older, is insignificant. People over 60 are having the hardest situation coping with the disease and more likely to die. vaccination coverage is now only 30.9% in the 60-69 age group. The situation is even worse in the age groups 70-79 and 80 years and older: 24.3% and 10.0%. People over 60 are having the hardest situation coping with the disease and more likely to die.

Today, vaccination coverage of the 60-69 age group is only 30.9%. The situation is even worse in the age groups 70-79 and 80 years and older: 24.3% and 10.0% accordingly. after analyzing the dynamics of vaccination coverage against COVID-19 in terms of age groups, it is found that the vaccine campaign is carried out randomly, priority risk groups by age, in which half of all deaths are registered, are not covered by information-explanatory work and as a consequence, they are poorly involved in vaccination. persons aged 50-59 and 40-49 years are the most actively involved into the vaccination campaign. At the end of week 45, people aged 60-69 years are only in the third place and last positions are occupied by the age groups 70-79 and 80 +. The gap between the most and the least covered by vaccination groups is 3.6 times.

After setting additional restrictions related to the introduction of the red level, epidemic danger significantly intensified the coverage dynamics of the population with the first dose of vaccine against COVID-19. But as of today, the picture in general does not differ from coverage by two doses. The greatest effect of the restrictive measures are observed in the age group of 18-19 years, coverage of which has doubled over the last month, from 23 to 46%. Persons aged 80 years and older who are at least covered by one dose of the vaccine by 13%. For the period from 1 September to November 13 mortality in this age group is incredibly high 15.2%

**Conclusions:** Today in Sumy region you can get vaccinated by highly effective Pfizer, Moderna, AstraZeneca, CoronaVac vaccines. Vaccinations are recommended primarily for people who did not have COVID-19, and also for those who have recovered, as well as older categories, which will help to save hundreds of lives without exaggeration.

**Key words:** vaccination, age groups, virus Delta

# IMPLEMENTATION OF NEW MASTER'S PROGRAMMES OF PHYSICAL THERAPY IN UKRAINE

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**Introduction:** Domestic higher education is gradually integrating with European higher education through reform. Since 2016, the speciality «Physical Therapy, Occupational Therapy» has been included in the field of health care, the standard of higher education for the bachelor's degree has been approved. The analysis of professional training of future physical therapists-masters showed insufficient consideration of the experience of the best European educational practices in physical therapy. In the absence of a standard for a master's degree in higher education, a real and powerful step towards improving the quality of education in this speciality can be considered the participation of domestic higher education institutions in the EU Erasmus + project «Innovative Rehabilitation Education – Introduction of new masters degree programs in Ukraine», (nr.598938-EPP-1-2018-1-LV-EPPKA2-CBHE-JP) (REHAB).

**Aim:** To analyze the results of the EU Erasmus+ project «Innovative Rehabilitation Education – Introduction of new masters degree programs in Ukraine» (2018-2022) in higher education institutions, project participants.

**Materials and Methods:** Methods of theoretical analysis and synthesis, concretization, generalization and systematization of practical pedagogical experience in training masters in physical therapy were used in four Ukrainian institutions of higher education, namely: the National University of Ukraine on Physical Education and Sport, Lviv State University of Physical Culture named after Ivan Boberskyj, I.Horbachevsky Ternopil National Medical University, Sumy State University. Latvian Academy of Sport Education (LASE); Satakunta University of Applied Sciences (SAMK), Józef Piłsudski University of Physical Education in Warsaw (AWF), Lithuanian Sports University (LSU) and European Federation of Adapted Physical Activity (EUFAPA) took part in the REHAB project from the European side.

**Results:** The results of the REHAB project can be presented in accordance with its main objectives. (1). Improving the professional potential of university teachers: weekly courses for teachers and students in the form of winter, autumn schools and a week of physical rehabilitation; numerous online lectures, seminars, workshops. (2). Creation of new resources for teaching/learning/assessment: new master's degree programs in physical therapy with a total of 120 ECTS credits have been developed; educational and methodical support (presentations of lectures, manuals, methodical recommendations, etc.) of all disciplines. As the project is supported by the Ministry of Education and Science of Ukraine, project partners from Ukraine were involved in the preparation of the KROK-2 state qualifying exams and the pilot of the Objective Structured Clinical Examination (OSCE). (3). Creation of a special educational infrastructure necessary for the implementation of a new national professional programme in physical therapy: created training and educational-scientific laboratories for physical rehabilitation, the equipment of which was purchased at the expense of the project; the library funds of the institutions are replenished with an English-language mini-library of the world's best textbooks and manuals.

**Conclusions:** It is believed that the main goals of the project have been achieved. In the future, it is planned to disseminate the results of the project to other institutions of higher education in Ukraine and constantly update the content of disciplines following current trends in European education in physical therapy. This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

**Key words:** rehabilitation, education, Erasmus +, quality of education, education reform

# DYNAMICS OF VEGETATIVE TONUS INDICES OF ELDERLY WOMEN UNDER THE INFLUENCE OF RECREATIONAL PHYSICAL ACTIVITY

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**Introduction:** The number of people aged 80 and older is projected to triple: from 143 mln in 2019 to 426 mln in 2050. Therefore, there is a need for defining an active ageing concept to improve the quality of life and involve the elderly into social and professional life. It has been proven that the sudden cardiac death risk is determined by a set of factors, one of which is autonomic imbalance. Therewith, understanding of autonomic imbalance in the elderly will allow for effective prevention of cardiovascular diseases, through selection of wellness programs.

**Aim:** To study autonomic balance of the elderly by conducting cardiointervalography following recreational physical activity.

**Materials and Methods:** The study involved 60 elderly women. The women from the Gr. 1 (n=24) were relatively healthy; the women from the Gr. 2 (n=17) suffered periodic increase in blood pressure up to 150/90 mm Hg; the women of the Gr. 3 (n=19) had stable arterial blood pressure values equal to 150/90 – 160/100 mm Hg, however they did not take any medications. Heart rate analysis was performed according to the method of R. M. Baievskyi. According to this method, vegetative reactivity is assessed by the ration of the stress index (SI1/SI2) when moving from horizontal (SI1) to vertical (SI2) position. Statistic parameters of heart rate were analyzed using CardiolabPlus computer system.

**Results:** The developed wellness program featured discussions of health-related topics, morning physical exercises and recreational walking. In the course of morning exercises, the women did a set of conventional exercises aimed at muscle relaxation, balance, motor coordination, vestibular apparatus training, 20 to 30 min. While doing morning exercises, the women were advised to focus more on breathing exercises. At the beginning of the program, 3 to 5 women wearing light clothing walked every other day during 45 minutes first at a slow pace 70 to 80 steps per minute for 1,500 m to 2,000 m distance. Starting from day 8, the route of 2,000 m to 2,500 m was set, walking pace was gradually increased up to 90-100 steps per minute and lasted 60 minutes. The educational part of the program included conversations with women about the need for lifestyle changes and compliance with the requirements of physical activity.

Vegetative reactivity index of the women from the Gr. 1 ( $SI2/SI1=1.85\pm0.32$  c.u.) showed a balance of autonomic nervous system. Dynamics of vegetative reactivity index of the women from the Gr. 2 was within the balance of autonomic nervous system. Thus, vegetative reactivity acquired a value of  $1.71\pm0.21$  c.u. compared to  $2.04\pm0.31$  c.u. at primary examination. In our opinion, the decrease in the stress index and vegetative reactivity indicated an improvement of vegetation stabilizing properties due to the effect of recreational physical activity. Initial vegetative reactivity of the women from the Gr. 3 ranged within eutonia ( $SI2/SI1=2.91\pm0.54$  c.u.) with significant *hypersympathicotonic reactivity*. After doing activities according to the program there was a tendency to decrease the rate of autonomic reactivity ( $SI2/SI1=2.04\pm0.33$  c.u.). We believe that the presence of tension in the regulatory autonomic and humoral systems in the body of the women from the Gr. 3 is a consequence of an uncontrolled increase in blood pressure.

**Conclusions:** That is, this study confirms conclusions of many scientists, that the influence of the sympathetic nervous system as well as activation of the parasympathetic division increases as a result of an elevation in blood pressure, which leads to the development of severe cardiac disorders. The development of recreational physical activity programs will promote good health, prolongation of active and high-quality life of middle aged people.

**Key words:** elderly age, heart rate variability, recreational physical activity

# COMPLIANCE TO PREVENTION OF ALCOHOL AND TOBACCO USE AS A RISK FACTOR OF RECURRENT MYOCARDIAL INFARCTION

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**Introduction:** Compliance to treatment is an important condition of treatment quality and effectiveness. Tobacco consumption has been recognized as one of the leading causes of health loss and premature death in both economically developed countries and developing ones.

**Aim:** To study the awareness and compliance to alcohol and tobacco use prevention of patients after myocardial infarction in the residual period of the disease.

**Materials and Methods:** To study awareness of risk factors and compliance to secondary prevention of myocardial infarction (MI), a representative sample was created by randomization, taking into account the proportional distribution in the population by age (under 65 and over 65 years old) and sex. Patients' awareness of risk factors, use of preventive measures and compliance to treatment were assessed on the basis of a questionnaire. 333 respondents took part in the questionnaire – 234 men (70,27%) and 99 women (29,73%), the average age – 62,5±9,8 years old.

**Results:** Women in the general sample were older (65,8±8,7 years old) than men (61,0 ±9,9 years old) ( $z=3,97$ ;  $p=0,0001$ ). The period after myocardial infarction averaged 2,5±1,6 years (from 0,5 to 7,0 years). The average term for the index event for women was 2,7±1,5 years, for men it was 2,4±1,6 years ( $z=1,60$ ;  $p=0,1$ ).

299 patients out of 333 (90,99%) answered «Yes» to the question «Do you use any methods to prevent cardiovascular disease, i.e. are you doing anything to reduce the risk of developing or worsening of these diseases?» (90,6% among men and 91,92% among women).

In order to determine patients' awareness of reducing the risk of recurrent heart attack, in terms of tobacco and alcohol use prevention, 15,92% (53 people) were aware that smoking cessation reduces the risk of recurrent heart attack. Among those informed people were 20,09% (47 people) of men and 6,06% (6 people) of women ( $\chi^2=9,21$ ;  $p=0,002$ ). 11,04% (33 people) said that they quit smoking to prevent a heart disease. Among the supporters were men – 14,9% (31 people) and women – 2,2% (2 people) ( $F p = 0,0004$ ).

16,52% (55 people) were aware that alcohol consumption decreasing reduces the risk of recurrent heart attack. Among those informed people were 20,94% of men (49 people) and 6,06% of women (6 people) ( $\chi^2=10,12$ ;  $p=0,008$ ). 10,70% (32 people) said that they reduced alcohol consumption to prevent a heart disease. Among the supporters were men – 13,46% (28 people) and women – 4,4% (4 people) ( $F p=0,01$ ).

It should be noted that 70,27% of respondents received recommendations from their doctors to smoke less or quit smoking, and 73,57% of respondents received recommendations from their doctors to drink less alcohol.

**Conclusions:** Low level of awareness of the possibility of risk factors modifying for recurrent heart attack is associated with a low compliance to non-drug secondary prevention measures after MI such as smoking cessation ( $F p=0,000$ ) and alcohol reduction ( $\chi^2=35,29$ ;  $p= 0,000$ ).

**Key words:** cardiac rehabilitation, preventive medicine, bad habits

# IMPLEMENTATION OF REMOTE MEDICAL SERVICE WITH FEEDBACK FUNCTION TO PROMOTE IMPROVEMENT OF HEALTH INDICATORS AND BEHAVIOR IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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**Introduction:** The formation of a healthy lifestyle and prevention of diseases remains a high-priority problem both at the national, regional levels and in the world. The level of health in population more than on half depends on the attitude of patients to their health and impact of modified risk factors (smoking, bad habits, increased blood pressure (BP), excess body weight, increased blood cholesterol, reduced physical activity), timeliness of seeking medical care (MC), constant monitoring of health indicators and awareness on importance of prevention of risk factors that lead to development of chronic non-infectious diseases (CNID), including type 2 diabetes mellitus (DM). All these factors should lead to formation of effective communication between the provider of medical services and population. Still, mechanisms of optimization of MC provision at the level of the healthcare institution (HCI) with active involvement of patient in the process of constant monitoring of health and treatment remain insufficiently studied. Their further studying and development would allow to conduct dynamic continuous monitoring of the patient, create conditions and stimuli to ensure a responsible attitude of population to prevention of diseases and formation of a healthy lifestyle.

**Aim:** To justify the relevance of using remote medical service with feedback function to improve health indicators and behavior in patients with type 2 DM at the level of primary health care (HC).

**Materials and Methods:** The form of the study was a survey, using a specially designed closed-type questionnaire, conducted during December 2019. The study used a systematic approach, bibliosemantic, comparative and statistical analyses, logical generalization.

**Results:** The study was conducted in 96 respondents: women –  $60,42 \pm 3,53\%$ ; men –  $39,58 \pm 3,53\%$ , among whom we implemented an algorithm of remote medical service with feedback function using information and communication system (ICS) within six months. Re-monitoring results' analysis showed that during the period of implementation of the ICS, the indicators of health and behavior of the respondents had improved. The proportion of patients who indicated that they regularly controlled the glycemia level increased by 31.24%. Those, who controlled the level of glycemia once a day before introduction of the ICS were only  $8,33 \pm 1,99\%$ ; those, who did it after introduction –  $20,83 \pm 2,93\%$ ; before the introduction of the ICS  $16,67 \pm 2,69\%$  controlled sugar level twice a day; after introduction –  $39,58 \pm 3,53\%$  controlled it twice. Also, proportion of patients who control their arterial BP every day (before introduction of ICS –  $43,75 \pm 5,06\%$ , after introduction –  $76,04 \pm 4,36\%$ ) increased by 32.29%. More respondents began to take medicines prescribed by a doctor regularly (increasing by 12.5%); more people began to follow diet and dietary regimen (increasing by 28.12%); 5.19% of respondents abandoned bad habits (smoking). Additionally, the number of respondents who have a body mass index  $\geq 30.0$ , was decreased by 4.69%.

**Conclusions:** The implementation of optimization algorithm for provision of MC to patients, using remote medical service and feedback function at primary level of MC has shown a positive effect on stimulating patients to dynamic monitoring on their health and behavior.

**Key words:** prevention of non-infectious diseases, remote medical care, improving the quality of medical care, behavior management

# CROSS-CULTURAL ADAPTATION AND CROSS-CULTURAL VALIDATION OF VISA-P FOR UKRAINIAN-SPEAKING PATIENTS

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**Introduction:** Motor dysfunctions of the knee joint caused by patellar tendinopathy («jumper's knee») are common among athletes both during the training process and after the end of a sports career. Conservative treatment and physical rehabilitation require reliable tools to assess and monitor their effectiveness. In the world practice of physical rehabilitation, the English-language VISA-P questionnaire, developed by the Australian Victorian Institute of Sports Assessment in 1998, is most frequently used for this purpose. During this time, the questionnaire was adapted and validated in different languages, but the Ukrainian version has not been available so far.

**Aim:** Carry out cross-cultural adaptation and validation of the VISA-P questionnaire for Ukrainian-speaking patients with patellar tendinopathy.

**Materials and Methods:** The VISA-P questionnaire consists of eight questions. Six of the eight questions assess the manifestations of pain in the knee joints in everyday life. The last two questions concern the ability to participate in sporting events. The intensity of pain is assessed on an inverted visual analogue scale from 0 to 10 points, in which 10 points correspond to the optimal health condition of the knee joints. Cross-cultural adaptation of the English-language VISA-P questionnaire was performed according to the recommendations of Beaton et al. Demographic characteristics (gender, age and number of sports hours per week) were documented for all test subjects. The internal consistency of the VISA-P questionnaire's questions was determined by the value of  $\alpha$ -Cronbach and the mean correlation coefficient. Statistical calculations were performed using the package STATISTICA version 6.0. A significance level of 5% was applied. Amount of 94 people were involved in the adaptation and validation of the questionnaire (20 people – to assess adaptation, 58 people – to assess reliability, 16 people – to assess validity).

**Results:** The Ukrainian version of the questionnaire was adapted in five successive stages. The latter was tested. It is determined that the coefficient of average correlation between questions (average inter-item corr.) of the scale is 0.47; the value of  $\alpha$ -Cronbach is 0.75, which indicates a good adaptation of questions in the Ukrainian language. Sufficient validation of the Ukrainian-language version of the questionnaire was confirmed by testing individuals with confirmed patellar tendinopathy by ultrasound and individuals with various complaints of knee dysfunction (8 in each group). A significant difference ( $p \leq 0.01$ ) was found between the results of the survey of these two groups. The proper sensitivity of the Ukrainian version of the VISA-P questionnaire is also confirmed by the absence of a «ceiling effect» and a «floor effect».

**Conclusions:** The VISA-P questionnaire for Ukrainian-speaking patients with patellar tendinopathy is equivalent to the original, characterized by satisfactory reliability and validity. Therefore, the Ukrainian version of the VISA-P questionnaire can be recommended for assessing and monitoring the process of physical rehabilitation of persons with patellar tendinopathy.

**Key words:** patellar tendinopathy, physical rehabilitation, jumper's knee

# THE USE OF THERA-TRAINER TIGO IN THE LONG-TERM REHABILITATION PERIOD FOR SPINAL CORD INJURY

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**Introduction:** Spinal cord injuries occur when the vertebral column is damaged due to fractures and injuries. They are manifested by a difficult complex symptom of motor, sensory and trophic disorders, the degree and nature of which depends on the location of the lesion. Paraplegia occurs when motor and/or sensory function is impaired or lost in the thoracic, lumbar or sacral segments of the spinal cord, secondary to damage to nerve elements in the spinal canal. In paraplegia the function of the hand is preserved, but the torso, legs and pelvic organs are mostly affected depending on the level of injury. Given the patient's health and the course of recovery processes in the body, rehabilitation care for such persons consists of three periods: acute, post-acute and long-term rehabilitation. Most often, rehabilitation continues throughout life.

**Aim:** To find out the possibility of improving the patient's functional state in long-term rehabilitation period with spinal cord injury by implementing a specially designed program of physical therapy with the involvement of the therapeutic device THERA-Trainer tigo.

**Materials and Methods:** Poll, somatometry, pulse-throwing, tonometry, dynamometry (brush strength), load intensity (Borg scale), goniometry.

**Results:** The study was attended by a patient aged 26 years with fragmentary fracture of the Th10-Th11 bodies of the ASIA A vertebrae in the consolidation stage in the long-term rehabilitation period (after the fire-wound abdomino-spine-spinal cord injury 4 years), who visited the clinic with the purpose of reduction of the overall disability, maintain and improvement of general physical form. Objectives of physical rehabilitation in the long-term rehabilitation period: reduction of progressive disability, regulation of muscle tone, improvement of emotional state, improvement of stabilization, strengthening of muscle corset, weight support. Achievement of the purpose is ensured by individual exercises and properly planned physical loads. The duration of the program was calculated for one month, 5 times a week (20 lessons, duration of one – 60 minutes). The program consisted of physical exercises of moderate loading, power and aerobic direction, passive mechanotherapy with the involvement of the therapeutic device THERA-Trainer tigo and exercises for relaxation. Dosing the amount and intensity of physical loading was carried out by the number of repetitions/approaches, change of pace of performance, methods of exercise, rational alternation of loading time and rest. A feature of the physical therapy program was its gradual, regulated by the feedback. The increase in load was carried out, provided close to normotonic, response to physical load, which was characterized by an increase in the frequency of heart rate by 40-50% from the indices of calm, an increase in the systolic blood pressure by 10-20%, constant diastolic blood pressure or a decrease of 5-10% and the restoration of these indicators after exercise for 5 minutes. The structure of the classes is: in the beginning – kinesiotherapeutic exercises for the torso and upper extremities, in the main part – passive mechanotherapy with the involvement of the therapeutic apparatus THERA-Trainer tigo, in the final – breathing exercises on relaxation. The therapeutic program positively influenced the cardiovascular and respiratory systems, the psycho-emotional state, strengthened the muscles of the upper extremities and the torso, improved the indicators of passive amplitude of movements in the hip, knee and ankle joints.

**Conclusions:** The introduction of a specially developed program of physical therapy with the use of the THERA-Trainer tigo improves the patient's functional condition in the long-term rehabilitation period after spinal cord injury.

**Key words:** physical therapy program, passive mechanotherapy, paraplegia

*(Summarys were published in the alphabetical order of authors' last names)*