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● HEALTH-RESORT MEDICINE ● PHYSICAL MEDICINE ● BIOCLIMATOLOGY

- Analysis of Physical Therapy in Ankylosing Spondylitis
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**SUBSCRIPTION:**

[prenumerata@wydawnictwo-aluna.pl](mailto:prenumerata@wydawnictwo-aluna.pl)

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# Analysis of Physical Therapy in Ankylosing Spondylitis

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Włodzisław Kuliński<sup>1</sup>, Kornel Antos<sup>2</sup><sup>1</sup>Department of Rehabilitation Military Institute of Medicine - National Research Institute, Warsaw, Poland<sup>2</sup>Collegium Medicum, Jan Kochanowski University, Kielce, Poland

## SUMMARY

**Aim:** The aim of the study was to assess the efficacy of physical therapy methods used in AS patients.**Materials and Methods:** The study group comprised of 30 individuals with ankylosing spondylitis aged 30 to 67 years, including 5 women and 25 men. The mean age was 43.4 years in women and 41.76 years in men. The largest patient group consisted of men aged 30 to 40 years. All patients lived in the Świętokrzyskie Voivodeship. The study used a diagnostic survey based on a questionnaire created by the authors. Study patients underwent physical therapy in the form of electrotherapy, laser therapy, ultrasound therapy, magnetic field therapy, cryotherapy, kinesiotherapy and massage.**Results:** The study showed that physical therapy reduced pain severity and increased the level of everyday functioning. Both the sign test ( $p\text{-value}\approx 0$ ) and the Wilcoxon signed-rank test ( $p\text{-value}\approx 0$ ) showed a significant difference in pain severity measured before rehabilitation vs. after rehabilitation (significance level,  $\alpha=0.05$ ).**Conclusions:** Physical therapy and rehabilitation is a key part of treatment in this group of patients.**Key words:** ankylosing spondylitis, treatment, physical therapy

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## INTRODUCTION

Ankylosing spondylitis (AS) is a chronic, progressive, inflammatory rheumatic disease. It is a spondyloarthropathy, which means it belongs to a heterogeneous group of autoimmune inflammatory disorders related to HLA-B27 and manifested within spinal joints. The prevalence of AS is between 0.3% and 0.5% in Europe and between 0.05% and 0.23% in the Caucasian population. Overall, AS affects approximately 0.2-1.4% of the global population. It is estimated to be found in 148 thousand people in Poland. The disorder is more common in men, with an incidence ratio of men to women of 3:1 to 2:1 [1-10].

Living with AS is a significant challenge. First of all, AS patients face everyday pain, which involves not only the spine, but often also multiple peripheral joints. They experience somatic comorbidities such as renal, cardiac, pulmonary, gastric, eye and neurological problems.

AS has a considerable influence on the patient's mental state. AS patients experience chronic stress and feel dependent on others. They worry that their health might deteriorate and are afraid of the future and of becoming disabled. This chronic stress results in mood disorders, depression, anxiety as well as personality and behavioral disorders.

The cause of AS is not fully known. Studies in families of AS patients revealed that there is a certain inherited tendency towards this disorder. First-degree relatives of AS patients have a 16-fold risk of developing AS themselves. The presence of the HLA-B27 antigen (found in 90% of patients) is a factor

that contributes to the development of AS. Other factors include interleukin 23 (IL-23) and ERAP1 aminopeptidase gene polymorphisms. Environmental factors that may trigger joint inflammation may include bacteria such as Shigella, Chlamydia, Yersinia and Salmonella as well as chronic bowel disease, particularly when HLA-B27 is present [11-14].

When the disease starts, plasma cell, lymphocyte and macrophage infiltrates appear in the synovial membrane of the sacroiliac joints. With time, granulation tissue develops and spreads to the subchondral bone and bone marrow; articular cartilage erosions and marginal sclerosis appear. Next, fibrous and osseous adhesions develop, leading to joint space fusion [12-15].

AS is a chronic condition whose symptoms vary in severity. In some patients, periods of worsening alternate with periods of remission; in others, AS is chronically progressive. Advanced untreated cases are associated with a typical posture that makes it possible to immediately diagnose the patient.

## RADIOGRAPHIC PRESENTATION

Radiographs show symmetrical inflammatory changes in the sacroiliac joints. These changes are divided into four grades:

- Grade 1: joint space narrowing,
- Grade 2: irregular joint space widening and marginal sclerosis in the bones,
- Grade 3: multiple erosions on bone surfaces,
- Grade 4: joint space fusion.



Magnetic resonance imaging (MRI) allows for very early detection of sacroiliac joint changes. It is important to refer patients for sacroiliac joint scan and not for a lumbosacral spine scan.

### AS DIAGNOSIS (DIAGNOSTIC CRITERIA)

Advanced AS is easy to diagnose due to the typical posture seen in the patients. However, diagnosing young individuals is quite different. Consequently, if a young patient presents with pain in the lower back and buttocks or with inflammation in a single lower limb joint, AS needs to be considered.

Modified New York diagnostic criteria for ankylosing spondylitis may help determine the diagnosis for epidemiological studies:

1. Lumbosacral pain persisting for at least 3 months, reduced by exercise but not relieved by rest.
2. Limited motion in the spine in the sagittal and frontal plane.
3. Limited chest expansion compared with normal values for that sex.
4. Grade 3-4 unilateral or grade 2-4 bilateral sacroiliitis in radiographic images.
5. Pain at night (reduced after getting up from a recumbent position).

Definite ankylosing spondylitis is established when criterion No. 4 and at least one of the other criteria are fulfilled [13-15].

### PHYSICAL THERAPY IN AS

Physical therapy is closely connected to disease activity in all inflammatory joint conditions, particularly in AS. In the acute period with severe pain, treatment is aimed at relieving pain, preserving muscle strength and ranges of movement, preventing incorrect joint positions and reducing joint load. The following physical therapy methods are used: cryotherapy, ultrasound therapy, electrotherapy, kinesiotherapy and massage [15-26]. In addition, limitation of physical activity for 2-3 days and bed rest are recommended if pain intensifies.

In the chronic period, once acute pain has resolved, treatment is aimed at restoring the static and dynamic function of the inflamed joint. If permanent damage is present, appropriate compensatory mechanisms need to be developed [17-22].

Systematic physical activity is crucial as it slows down AS progression. It is also important to maintain good posture during everyday activities. The environment at the patient's workplace should be modified depending on how advanced the disease is.

### AIM

The aim of this study was to assess the efficacy of physical therapy methods used in patients with ankylosing spondylitis (AS). The following research questions were formulated:

1. Does physical therapy reduce pain severity in AS patients?
2. Did the management used in AS patients increase their level of everyday functioning?
3. Assessment of efficacy of the physical therapy methods used in study patients.
4. What is the duration of improvement after treatment?

## MATERIALS AND METHODS

The study involved 30 patients, including 5 women and 25 men, diagnosed with AS and treated at a rehabilitation clinic in Kielce between 1 February 2021 and 31 May 2021. The patients were aged 30 to 67 years and the mean duration of AS was 2 to 5 years. The mean age was 43.4 years in women and 41.76 years in men. The largest patient group consisted of men aged 30 to 40 years (Table 1). Study patients received physical therapy in the form of electrotherapy, ultrasound therapy, laser therapy, magnetic field therapy, cryotherapy, kinesiotherapy and massage.

**Table 1.** Age categories in the study group

| Variable        | Category | N  | %     |
|-----------------|----------|----|-------|
| Age of patients | 30-40    | 14 | 46.66 |
|                 | 41-50    | 8  | 26.67 |
|                 | 51-60    | 5  | 16.67 |
|                 | 61-70    | 3  | 10    |

The study used a diagnostic survey based on a questionnaire created by the authors. The questionnaire consisted of 30 questions.

The first questions were aimed at collecting general information, such as age, sex, education, trade/profession, marital status. The next questions asked about the diagnostic process: who diagnosed the patient, how much time had passed from the onset of symptoms, any family history of AS, HLA-B27 status. The following questions helped determine the time and type of early symptoms, the present symptoms, the objective condition of the patient, the time of initiation of physical therapy and the sequelae of AS found in the patient.

### STATISTICAL ANALYSIS

The results obtained in the study were statistically analysed. Both the sign test ( $p\text{-value}\approx 0$ ) and the Wilcoxon signed-rank test ( $p\text{-value}\approx 0$ ) showed a significant difference in pain severity measured before rehabilitation vs. after rehabilitation (significance level,  $\alpha=0.05$ ). The mean score in the study group was 4.93 before rehabilitation and 3 after rehabilitation. The difference was also reflected in the median: the median was 5 before rehabilitation and 3 after rehabilitation. These results show that rehabilitation significantly reduced pain in study patients.

The detailed results are as follows. Both the sign test ( $p\text{-value}\approx 0$ ) and the Wilcoxon signed-rank test ( $p\text{-value}\approx 0$ ) show a significant difference in pain severity assessed before kinesiotherapy vs. after kinesiotherapy (significance level,  $\alpha=0.05$ ). The mean score in the study group was 2.43 before rehabilitation and 7.33 after rehabilitation.

The same tests indicate a significant difference in pain severity assessed before vs. after massage. The mean score in the study group was 2.43 before rehabilitation and 8.87 after rehabilitation. Similar results were seen in the case of electrotherapy; the mean score in the study group was 2.43 before rehabilitation and 7.47 after rehabilitation. For laser

therapy, the mean score in the study group was 2.43 before rehabilitation and 5.64 after rehabilitation. In the case of cryotherapy, the results also indicate statistical significance as the mean score in the study group was 2.43 before rehabilitation and 7.5 after rehabilitation.

The Mann-Whitney U test does not provide the rationale to reject (at the significance level of  $\alpha=0.05$ ) the hypothesis that there are no differences between men and women in terms of the study characteristics. Consequently, there are no differences between men and women with respect to everyday functioning and pain severity before and after all physical therapy procedures.

### RESULTS

The majority of the 30 study patients had secondary education (63.34%) (Table 2) and were employed (93.34%) (Table 3).

**Table 2.** Level of education of study patients

| Variables          | Category  | N  | %     |
|--------------------|-----------|----|-------|
| Level of education | Primary   | 0  | 0     |
|                    | Secondary | 19 | 63.34 |
|                    | Higher    | 11 | 36.66 |

**Table 3.** Social status of study patients

| Variables     | Category   | N  | %     |
|---------------|------------|----|-------|
| Social status | Unemployed | 2  | 6.66  |
|               | Employed   | 28 | 93.34 |

Most study patients (73.34%) were married (Table 4). Almost half of study patients had children; some patients had several children.

All study patients were diagnosed by a rheumatologist. Time to diagnosis differed between patients and was usually (76.7%) over 2 years. All study patients had a family member with AS (mother, father, sibling). The majority (95%) had a positive result of HLA-B27 testing. Associated diseases in the studied patients are presented in Table 5.

**Table 4.** Marital status of study patients

| Variables | Category | N  | %     |
|-----------|----------|----|-------|
|           | Single   | 5  | 16.67 |
|           | Married  | 22 | 73.34 |
|           | Divorced | 3  | 9.99  |

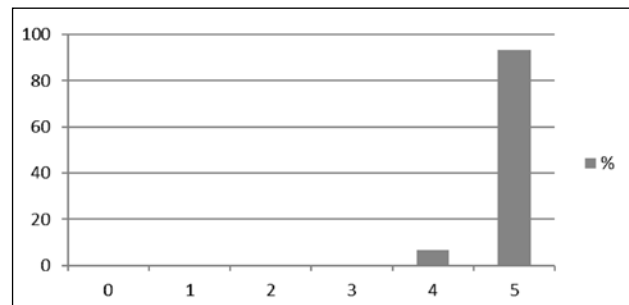
**Table 5.** Comorbidities in study patients

| Variable      | Category        | N | %     |
|---------------|-----------------|---|-------|
| Comorbidities | Coeliac disease | 3 | 18.75 |
|               | Gastric ulcers  | 4 | 25    |
|               | Iritis          | 2 | 12.5  |
|               | Osteoporosis    | 1 | 6.25  |
|               | Renal disease   | 2 | 12.5  |
|               | Atherosclerosis | 2 | 12.5  |
|               | Depression      | 2 | 12.5  |

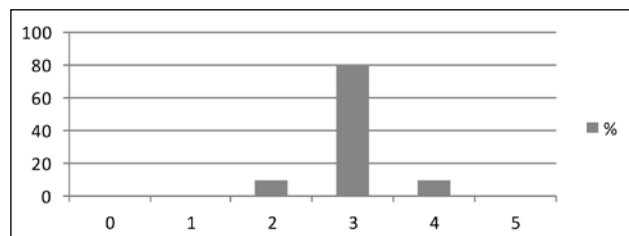
The study showed that patients experienced pain the whole time, but pain severity changed over time. Study patients described their pain levels before treatment as very high, with over 90% of patients selecting 5 on a scale from 0 to 5 (Figure 1). These results changed after treatment (Figure 2).

Pain affected everyday functioning to a very high degree. Study patients described their everyday functioning level before treatment as low, with over 73% (Figure 3) rating it at 2 points. However, the results were different after treatment (Figure 4) and the everyday functioning level increased by 2 points; 88% of study patients rated it at 4 points and 12% rated it at 5 points.

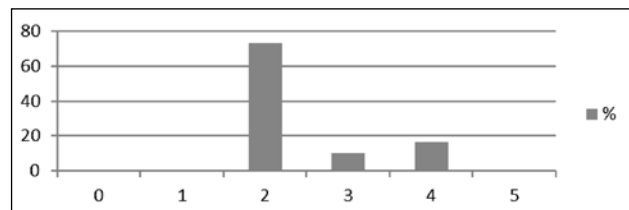
Cryotherapy was another physical therapy method whose efficacy was assessed in the study. Cryotherapy procedures were performed in all study patients. Study patients rated the efficacy of cryotherapy and the duration of its effects very



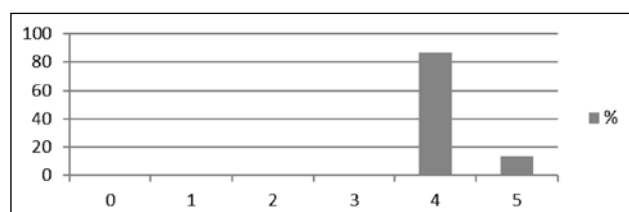
**Figure 1.** Pain before treatment



**Figure 2.** Pain after treatment



**Figure 3.** Everyday functioning before treatment



**Figure 4.** Everyday functioning after treatment



favourably. Figure 5 shows that over 80% of study patients rated its efficacy at 8 points. In some patients, effects of cryotherapy persisted for 3 months (10%).

Electrotherapy was performed in all study patients. Study patients rated electrotherapy procedures relatively favourably; 20 patients (66%) rated it at 8 points and 5 patients rated it at 7 points (Figure 6). The effects of electrotherapy persisted for up to 3 months in 20% of study patients.

Some study patients did not receive laser therapy; those who did described it as moderately effective, with 10 patients rating it at 5 points, another 10 rating it at 6 points and 2 patients rating it at 7 points (Figure 7). The vast majority of patients (almost 100%) reported that effects of laser therapy persisted for several weeks.

Magnetic field therapy was performed in nearly 87% of study patients and was rated similarly to laser therapy. The largest group of patients (46%) rated it at 6 points.

The study showed that ultrasound therapy was relatively uncommon in AS. Over 73% of study patients did not undergo ultrasound therapy procedures; those who did described them as moderately effective (75% of patients rated them at 4 points) (Figure 8).

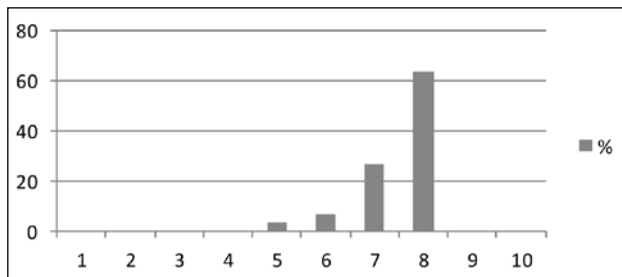


Figure 5. Efficacy of cryotherapy

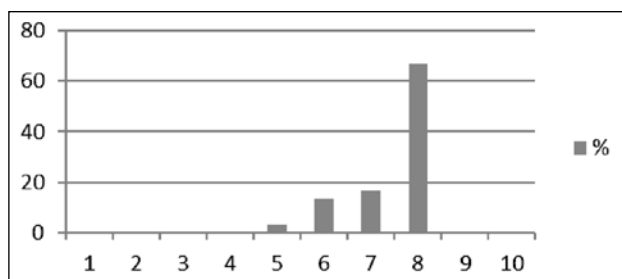


Figure 6. Efficacy of electrotherapy

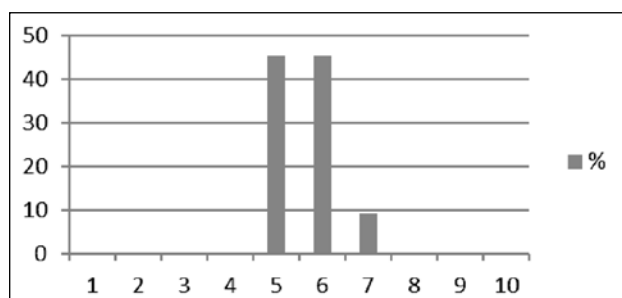


Figure 7. Efficacy of laser therapy

Hydrotherapy was performed in 60% of study patients. The patients described it as moderately effective, with 50% rating it at 5 points and almost half rating it at 6 points (Figure 9). Study patients believed that the effects of hydrotherapy persisted for several weeks.

Kinesiotherapy and massage were used in all study patients. Both types of procedures were rated favourably, as shown in Figures 10, 11. The effects persisted for up to 3 months in the case of kinesiotherapy (10%).

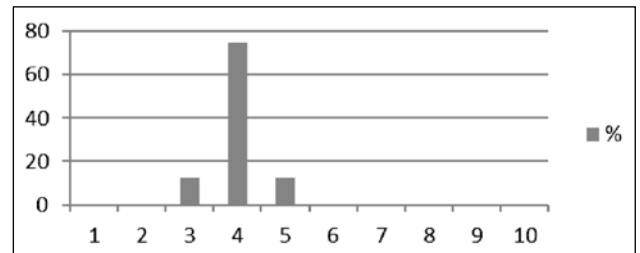


Figure 8. Efficacy of ultrasound therapy

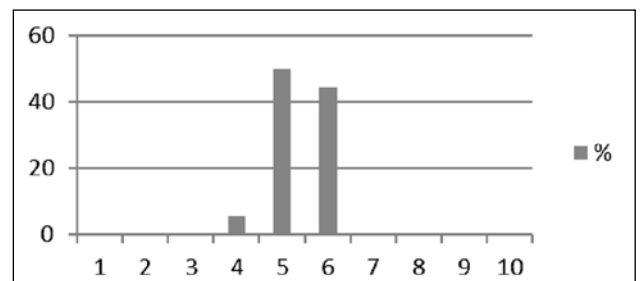


Figure 9. Efficacy of hydrotherapy

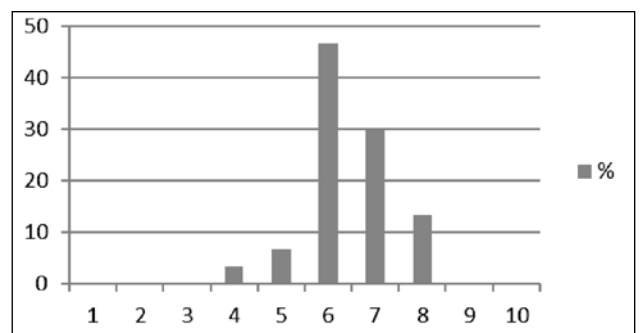


Figure 10. Efficacy of kinesiotherapy

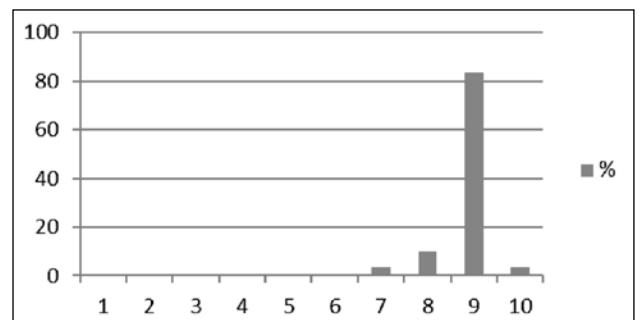
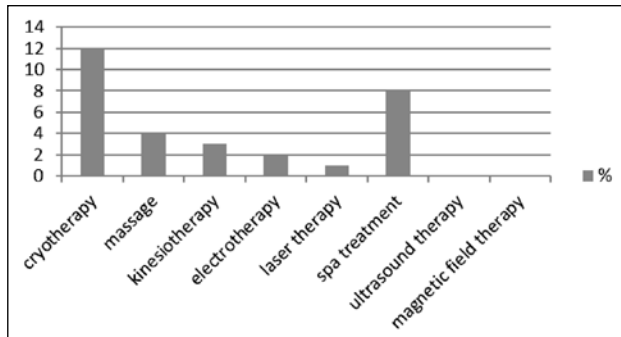


Figure 11. Efficacy of massage



**Figure 12.** Most effective physical therapy procedures as assessed by study patients

Medical resort was the last physical therapy method assessed by study patients. Only 8 out of 30 study patients (26.7%) had an opportunity to receive spa treatment; they rated the efficacy of this type of treatment favourably.

Study patients were asked to indicate which treatment methods were the most effective. According to Figure 12, cryotherapy and spa treatment were the highest rated treatment options.

The last group of questions were open-ended questions concerning the psychological aspects of AS. Study patients were asked to describe in detail what the disease had given them and what it had taken away from them. The answers were very different. Things the patients lost due to AS included attractiveness, financial safety, feeling of being in control and independence, happy relationship, ability to work in their trained profession or trade, ability to continue their professional development, aspirations, self-worth, friends and ability to enjoy their life.

However, AS also gave them some things. Study patients wrote that their disease had given them hope and strength and showed them they could live with pain. What is more, it also let them meet wonderful people who became their friends and loved ones. Many patients said that their disease helped them re-evaluate their lives. They preferred to “be” than “have” and they appreciated every moment of their life.

## DISCUSSION

Ankylosing spondylitis (AS) is an autoaggressive, rheumatic, multisystem disease that makes life very difficult for the patients. It is important to ensure early diagnosis and prophylaxis that will prevent joint contractures and deformities [5-9].

Unfortunately, the onset of AS may go unnoticed. The present study showed that time to diagnosis was two years in almost 77% of patients. These findings are consistent with those reported by H. Geesing [9], who noted that early symptoms may be misleading even to an experienced rheumatologist.

One might ask whether routine blood testing should not include antibody tests aimed at detecting any autoaggressive disease, especially in patients who regularly complain of spinal pain. Maybe an HLA-B27 test would allow for formulating a quick and correct diagnosis. In the present study, 95% of patients were HLA-B27-positive. This is a large number considering the study group was small.

Maybe gynaecologists or urologists treating patients with bacterial urogenital infections (e.g., chlamydia) should include bone and joint symptoms in their history-taking. Over 12.5% patients assessed in this study had renal disease. The situation is similar with respect to gastrointestinal disease. The authors believe that gastrologists should monitor patients with gastric ulcers or coeliac disease more closely. It is common knowledge that autoaggressive conditions tend to develop in groups, or at least “in pairs”. A deeper diagnostic work-up may be suggested with respect to other autoaggressive conditions, for example rheumatic disease. Almost 20% of study patients had coeliac disease; it is likely that this condition had developed first. Moreover, many study patients (25%) had gastric ulcers. One should remember that there is a lot of clinical, experimental and epidemiological data that prove there is a correlation between bowel disease and musculoskeletal disorders.

Early detection of AS is important not only due to the role of prophylaxis, but also because it helps patients plan their lives with this disease. The study showed that all patients had a family history of AS. In many cases, study patients had not been previously tested for AS despite the fact that their mother, brother or sister had already been diagnosed with AS. Appropriate diagnostic process started probably after the onset of symptoms. However, in such cases it should be possible to plan one’s future education or profession taking into consideration potential limitations due to AS. The study shows that the patients did not do this since not a single person worked in their trained profession or trade. Some patients (almost 7%) were unemployed. It is not known whether this situation resulted from their learned helplessness or whether their health was already so poor that they were unable to work. A relatively large group of patients (63.34%) had secondary education. This raises the question whether their level of education was related to their lower aspirations, which may be a social consequence of AS, or whether it was a natural consequence of living in constant pain.

Study patients were asked to rate their pain severity on a scale from 0 to 5 both before and after treatment. It turned out that the level of pain before treatment was usually very high at 5 points and decreased after treatment to around 3 points. Ten physical therapy methods were used in study patients, namely heat therapy, cryotherapy, electrotherapy, laser therapy, magnetic field therapy, ultrasound therapy, hydrotherapy, massage, kinesiotherapy and spa treatment.

Study patients had a favourable opinion about cryotherapy, with 80% rating it at 8 points (on a scale to 10). Moreover, 10% of study patients declared that the effects of cryotherapy persisted for 3 months, which is a good result that definitely stems from the proven anti-inflammatory and antioxidant activity of cryogenic temperatures. In Poland, studies on the effects of cryotherapy on the functioning of AS patients have been conducted for example by A. Stanek and her colleagues. Multiple studies have been performed on male patients that assessed the effects of cryotherapy on the level of pain and tension, complete blood count parameters, changes in individual protein fractions and the level of FRAP in the plasma [19, 20].

### KINESIOTHERAPY WAS FOUND TO BE EFFECTIVE BY STUDY PATIENTS.

Study patients had a favourable opinion about spa treatment. Their positive opinion concerned both treatment efficacy and the duration of treatment effects. Unfortunately, not many patients (only 26.7%) had an opportunity to undergo spa treatment. Those who did undergo spa treatment said that this was the only physical therapy method with long-term effects (persisting up to six months).

To sum up, all physical therapy methods assessed in the study had a positive influence on the physical and mental health of AS patients and helped eliminate or reduce pain and increase their level of everyday functioning.

### CONCLUSIONS

1. Ankylosing spondylitis is a difficult clinical and social problem.
2. Early diagnosis is important.
3. Physical therapy reduced pain and increased the level of everyday functioning.
4. Physical therapy is a key part of treatment in this group of patients.

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### ADDRESS FOR CORRESPONDENCE:

Włodzisław Kuliński

K. Miarki 11 B St.

01-496 Warsaw, Poland

e-mail: wkulinski52@hotmail.com

### ORCID ID and AUTHORS CONTRIBUTION

0000-0002-6419-4030 –Włodzisław Kuliński (A, C, D, E, F)

Kornel Antos (B, C, D)

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

# Complex Rehabilitation of Patients with Parkinson's Disease

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**Iryna Khubetova**

Odesa Regional Hospital, Odesa, Ukraine

## SUMMARY

**Aim:** To assess the clinical effectiveness of a comprehensive rehabilitation program for patients with Parkinson's disease**Materials and Methods:** The study was conducted in the regional center for movement disorders (Odesa, Ukraine). 90 patients with 1-2.5 Hoehn-Yahr stage were examined. Patients were randomly assigned to three groups (I (n=30) – standard drug therapy, II (n=30) – standard drug therapy + physical therapy, III (n=30) – standard drug therapy + physical therapy + art therapy). The effectiveness of the therapy was assessed using the UPDRS questionnaires, Beck Depression Inventory (BDI), Montreal Cognitive Assessment (MoCA), and Pegboard Test. The follow-up period was 12 months.**Results:** Patients of the II and III groups noted an improvement in mood after physical exertion. They observed a decrease in daytime sleepiness, a decrease in tremors, and a decrease in the intensity of anxiety and fear. During the observation period, signs of disease progression were observed only in 4 (13.3%) patients of group II, in 2 (6.7%) patients of group III and in 12 (40.0%) patients of the control group (respectively,  $\chi^2 = 4.18$   $p = 0.04$  and  $\chi^2 = 7.55$   $p = 0.006$ )**Conclusions:** 1. The use of complex rehabilitation allows to reduce the severity of motor and non-motor manifestations of Parkinson's disease. 2. The inclusion of art therapy in the complex rehabilitation program allows to halve the number of cases of disease progression. 3. The positive effect of the use of comprehensive rehabilitation is maintained throughout the observation period.**Key words:** Parkinson's disease, rehabilitation, physical therapy, art therapy

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## INTRODUCTION

Parkinson's disease (PD) is a chronic progressive neurodegenerative disease that affects about 9,000,000 people worldwide [1, 2]. Globally, the indices of disability and mortality due to PD is increasing much faster than in the case of any other disease of the nervous system. According to WHO experts, the prevalence of PD has doubled over the past 25 years [1]. Preliminary estimates determined that PD leads to the loss of 6 million YLD annually [3].

Rehabilitation is considered as an adjunct to pharmacological and surgical treatment of PD to maximize functional capacity and minimize secondary complications [4]. Initially, rehabilitation approaches were based on empirical experience, but increasing evidence suggests that exercise-dependent plasticity is the primary mechanism underlying the effects of physical therapy. Exercises increase the efficiency of synapses and affect neurotransmission, thus potentiating functional circuits in PD [4, 5]. In addition, exercise is a key element of motor learning. Patients with PD retain sufficient ability for motor learning, although learning speed and productivity are lower compared to practically healthy individuals and patients with other pathologies, without the involvement of extrapyramidal structures [5].

Recent meta-analyses have shown that rehabilitation can produce short-term but clinically important positive

effects, especially for gait and balance [6, 7]. However, rehabilitation interventions are largely heterogeneous (stretching exercises, muscle strengthening, balance, postural exercises, occupational therapy, Nordic walking, treadmill training), and there is still no consensus on the optimal approach to prescribing them. Recently, innovative methods have been proposed: virtual reality and interactive video games (exergaming), the technique of motor imagery and action observation, physiotherapy using robots and non-traditional treatment methods (for example, dance, tai chi, martial arts), balneotherapy, etc. [8-14].

A rehabilitation program for patients with parkinsonism should be "goal-oriented" (directed to the practice and study of specific activities in the main areas of motor activity), but a number of practical variables (intensity, specificity, complexity) should be defined, and the program should be adapted to individual characteristics patients [4, 14]. When planning an individual rehabilitation program, they rely on the requirements of the ICF (International Classification of Functions) and current MDS guidelines [15, 16].

## AIM

The study was aimed to assess the clinical effectiveness of a comprehensive rehabilitation program for patients with Parkinson's disease



## MATERIALS AND METHODS

The study was conducted on the basis of the regional center of movement disorders (Odesa, Ukraine). 90 patients with Parkinson's disease with preserved ability to move independently – stage 1-2.5 according to Hoehn-Yahr were examined. Patients were randomly assigned to three groups. The first, control group consisted of 30 patients who received standard drug therapy, the second group consisted of 30 patients who, in addition to standard drug therapy, regularly (5-6 hours per week) did physical exercises under the supervision of an instructor. The third group consisted of 30 patients who, along with standard drug and physical therapy, received art therapy sessions, including sculpting, drawing on a free theme, and coloring standard dotted pictures (Figure 1).

Physical therapy included mime exercises, muscle stretching exercises (pulling and flexion of the back; neck stretching), circular rotations of hands and shoulders; spreading the fingers; raising legs while sitting on a chair; twisting the trunk in a sitting position; tilt to the sides of the head and body. Exercises were performed in a sitting position, and in patients without pronounced postural instability - also lying down. The patients did exercises during the period of action of the drugs (on-period).

Art therapy sessions were held with the participation of professional artists and lasted 60 minutes.

The average age of the patients was  $57.4 \pm 1.8$  years, men slightly predominated in the sample (49 or 54.4%). All study participants signed an informed consent approved by the LEC.

The effectiveness of the therapy was assessed using the UPDRS questionnaires [17], Beck Depression Inventory (BDI), Montreal Cognitive Assessment (MoCA) and Pegboard Test [17-20]. The assessment was carried out before the start of classes, after 6 and 12 months. The effectiveness of the treatment was evaluated by the frequency of disease progression (an increase in the Hoehn-Yahr score by 0.5 points or more during the year).

Statistical processing was performed by the ANOVA method with post-hoc Bonferroni correction. When comparing the frequencies of occurrence of clinically significant events, the Yates corrected  $\chi^2$  criterion was used [21].

## RESULTS

When analyzing the distribution of patients according to the severity of the disease, it was found that in the studied group

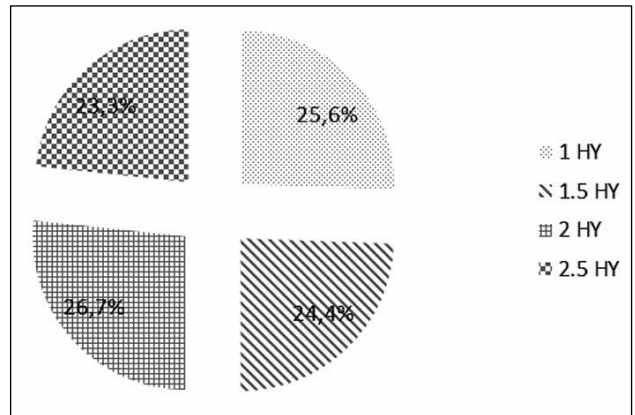


Figure 2. Distribution of patients by disease severity

there were 23 (25.6%) patients with stage 1 HY, 22 (24.4%) patients with stage 1.5 with HY, 24 (26.7%) patients with stage 2 HY, 21 (23.3%) patients with stage 2.5 HY (Figure 2).

During the entire period of the study, patients of the II and III groups noted an improvement in mood after physical exertion. They observed a decrease in daytime sleepiness, a decrease in tremors, and a decrease in the intensity of anxiety and fear.

When analyzing the dynamics of the indicators according to the psychometric scales of the questionnaires, it was established that patients of the III group have the most pronounced positive changes in the form of a decrease in the intensity of motor and non-motor manifestations of Parkinson's disease (Table 1).

During the observation period, signs of disease progression (at least 0.5 points according to Hoehn-Yahr) were observed in 4 (13.3%) patients of group II, in 2 (6.7%) patients of group III and in 12 (40.0%) patients of the control group (respectively,  $\chi^2 = 4.18$   $p = 0.04$  and  $\chi^2 = 7.55$   $p = 0.006$ ).

## CONCLUSIONS

1. The use of complex rehabilitation allows to reduce the severity of motor and non-motor manifestations of Parkinson's disease.
2. The inclusion of art therapy in the complex rehabilitation program allows to halve the number of cases of disease progression.
3. The positive effect of the use of comprehensive rehabilitation is maintained throughout the observation period.



Figure 1. Art therapy classes

**Table 1.** Results of assessment by tests (M±SE)

|                                | Basic    | In 6 months | In 12 months | Basic    | In 6 months | In 12 months | Basic    | In 6 months | In 12 months |
|--------------------------------|----------|-------------|--------------|----------|-------------|--------------|----------|-------------|--------------|
| UPDRS I, scores                | 5,6±0,5  | 5,1±0,4     | 4,9±0,4      | 5,4±0,6  | 4,9±0,5     | 4,5±0,4      | 5,5±0,5  | 4,8±0,4     | 4,3±0,3      |
| UPDRS II, scores               | 17,7±1,3 | 16,9±1,3    | 16,6±1,3     | 17,5±0,9 | 16,7±1,3    | 16,3±1,3     | 17,5±1,3 | 16,3±1,3    | 16,0±1,1     |
| UPDRS III, scores              | 33,3±1,8 | 30,5±1,6    | 29,5±1,6     | 33,5±2,1 | 30,3±1,8    | 27,8±1,8     | 33,6±1,7 | 30,2±1,6    | 26,9±1,6     |
| BDI, scores                    | 7,9±0,6  | 7,4±0,3     | 7,1±0,7      | 7,9±0,7  | 7,2±0,6     | 6,9±0,7      | 7,8±0,6  | 7,1±0,7     | 6,8±0,6      |
| Pegboard test, pins per minute | 22,3±1,5 | 26,9±1,8    | 27,4±1,6     | 22,2±1,4 | 27,7±1,3    | 27,0±1,3     | 22,4±1,3 | 28,2±1,6    | 18,9±1,3     |
| MoCA, scores                   | 27,1±0,3 | 26,8±0,2    | 26,6±0,3     | 27,0±0,2 | 26,5±0,2    | 25,9±0,3     | 27,2±0,3 | 26,4±0,3    | 25,5±0,3     |

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**ADDRESS FOR CORRESPONDENCE:**

**Iryna Khubetova**

Odesa Regional Hospital, Odesa, Ukraine

e-mail: khubetova@i.ua

**ORCID ID and AUTHOR CONTRIBUTION**

0000-0002-2860-9622 – Iryna Khubetova (A, B, C, D, E, F)

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



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# The Impact of WATSU as Physiotherapy Method on Fatigue for People Diagnosed with Multiple Sclerosis

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**Julija Andrejeva<sup>1,2,3</sup>, Elinga Mockute<sup>2</sup>, Grazina Sniepiene<sup>1,2</sup>, Elvira Malyško<sup>3</sup>, Natalja Istomina<sup>2,3</sup>, Vaiva Hendrixson<sup>3</sup>**<sup>1</sup>Klaipėdos Valstybinė kolegija / Higher Education Institution, Faculty of Health Sciences, Klaipėda, Lithuania<sup>2</sup>Klaipėda University, Faculty of Health Sciences, Klaipėda, Lithuania<sup>3</sup>Vilnius University, Faculty of Medicine, Vilnius, Lithuania

## SUMMARY

**Aim:** To identify the impact of WATSU method on fatigue which has an impact on sleep and quality of life, pain and depression or its aggravation.**Materials and Methods:** The study involved the four participants. The following instruments were used: Multiple Sclerosis Quality of Life questionnaire; Pittsburgh Sleep Quality Index; Burns Depression Checklist; Fatigue Impact Scale. The study was carried out in medical center in Lithuania from 09-11-2019 till 18-01-2020 during 10 weeks. Each participant of the study received ten WATSU sessions. The research data was processed using SPSS Statistics 20. Qualitative Outcome Measures were conducted by content analysis, observation, semi-structured individual interview methods.**Results:** After 10 sessions, fatigue lessened in all people investigated. Initially, the average of fatigue was 70 points and decreased to 34 points after the investigation. The average sleep quality index was as high as 5 points, after ten weeks the average decreased to 3 points. Changes in assessment of major to mild depression: initially, the average was 36 points, which decreased to 14 points after ten weeks.**Conclusions:** The WATSU method was effective in reducing fatigue as a physiotherapy method. Along with changes in fatigue, the Pittsburgh Sleep Quality Index decreased, energy and motivation increased, quality of life improved, level of depression reduced, and the change was statistically significant. While assessing the quality of life, pain was found to be decreased – it became less frequent after ten weeks of sessions and less intense or even absent, its influence on daily activities decreased.**Key words:** multiple sclerosis, fatigue, rehabilitation, aquatic physical therapy, WATSU

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## INTRODUCTION

Studies with limited evidence have described the use of WATSU in people with stroke [1], cerebral palsy [2] and fibromyalgia [3, 4], which was effective in the latter in reducing pain, improving depression [3] and health related quality of life [4]. A watery rehabilitation environment is a form of exercise that provides the most appropriate therapeutic environment for individuals with multiple sclerosis. The National Association for Multiple Sclerosis recommends aquatic exercise therapies to patients. The effects of aquatic exercises on multiple sclerosis patients revealed a number of positive effects after investigations [5].

Multiple sclerosis (MS) is a chronic progressive neurological disease that is incurable yet [6]. It is an autoimmune inflammatory CNS demyelinating disease that attacks the protective myelin covering of the nerve fibers responsible for muscle functioning and senses [7]. Almost 2 300 000 people in the world suffer from MS and the overall prevalence of the disease is 33 out of 100 000. Epidemiological studies suggest that the incidence and prevalence of MS are geographically dependent [6]. The prevalence of the disease in the world is

unevenly distributed between economically strong and weak countries. In North America and Europe >100 out of 100 000 population have MS, whereas in Asia and Africa only 2 out of 100 000 population are affected by the disease [8]. The numbers of MS patients are increasing globally (from 2.1 million in 2008 to 2.3 million in 2020). Among the 29 European states Lithuania ranks 23rd by MS morbidity rate. Lithuania belongs to the area of high MS prevalence, with 70–80 new cases of multiple sclerosis registered each year, and approx. the total number of patients may reach 3 000. The average age of the patients is 29 years. In Lithuania MS is more common in women than men with 2:1 MS incidence rate between women and men [9].

Fatigue is the most common symptom among multiple sclerosis patients. It occurs at an early stage of the disease, often earlier than other symptoms, and may indicate the disease progression [10]. Fatigue or exhaustion may be associated with physical (motor activity) and mental (cognitive or emotional) activity. Usually it is a normal reaction of the body. However, it is considered pathological when it bothers and affects the social, physical and work activities of individual [11]. There are

two types of MS related fatigue: primary and secondary. The primary fatigue occurs without any reasons and it comes directly from the disease. The secondary fatigue is the consequence of other conditions related to MS, most often related to the side – effects of MS medication or physical activity. The fatigue has a negative effect on quality of life and cognitive functions of the patient. The primary fatigue may be difficult to tell apart from the secondary fatigue because it can be caused by other co – morbid conditions such as depression [6, 12]. MS patients feel abnormal subjective fatigue and many other neurological disorders due to a possible increase in the brain workload to perform a cognitive or physical task or due to a mismatch between the desired workload and the actual workload that neurons can perform [13]. The fatigue can be peripheral (inability to maintain muscle contraction) and central (increased effort and decreased endurance during long – term physical or cognitive activity). The central fatigue is associated with metabolic and structural disorders that disrupt the normal functioning between the basal nuclei, the limbic system, and the primary sensory areas [14]. The fatigue can be acute or chronic. The acute fatigue is usually related to acute conditions, whereas in the case of MS the fatigue is chronic [15]. Different studies and meta analyses revealed that 50–90 percent of MS patients suffer from a certain level of fatigue [15, 16]. It is often one of the first symptoms that undermines daily activities and has a negative effect on the professional and personal relationships [17]. Our study will provide additional knowledge on aquatic rehabilitation methods for patients diagnosed with multiple sclerosis.

WATSU (portmanteau word: English “water” and Japanese 指圧 “Shiatsu”) was first described by its originator Dull in the 1980s as a treatment consisting of Japanese Shiatsu bodywork applied in thermal water [18]. To practice WATSU, a therapist stands in thermoneutral water ( $35^{\circ}\text{C} = 95^{\circ}\text{F} = 308.15\text{ K}$ ), supporting the supine receiver with hands, forearms, or shoulders and softly moving her / him in slow and spacious circular motion sequences following elaborate movement patterns related to receiver’s and therapist’s level of experience [18]. The hands of the therapist function as a grip to facilitate movement and at the same time to stimulate acupuncture points. Gentle traction is applied to the body of the receiver to mobilize joints and stretch myofascial structures, as well as meridians, channels through which the life-energy (Chinese 氣 “qi”, flows in the concept of Traditional Chinese Medicine [18, 19]. During immersion, hydrostatic pressure influences fluid distribution, metabolism, and respiration. The impact of gravity is greatly reduced, thus decreasing joint loads and allowing maximal flexibility in the positioning of the treated individual [20, 21]. The thermoneutral temperature of  $35^{\circ}\text{C}$  is recommended because it allows passive immersion of about 60 minutes without causing temperature-induced stress [21-23]. Originally WATSU was created as a non – therapeutic application to support wellbeing and relaxation, and was consequently adopted by therapists. Therefore, therapeutic indications of WATSU are reported in the literature, e.g. to address musculoskeletal conditions [4, 24], neurologic diseases [25-27] and mental distress [28-30], to complement palliative

care [31, 32] or to meet the needs of cognitively impaired individuals [33-36]. Originating in the Asian philosophy of maintenance and restoration of health, WATSU can be considered as a floating massage, a tool for rehabilitation, a guided meditation to foster mindfulness and resilience, and a mediator of personal and spiritual growth [37-39].

## AIM

The study purpose was to identify the impact of WATSU method on fatigue which has an impact on sleep and quality of life, pain and depression or its aggravation.

## MATERIALS AND METHODS

### PARTICIPANTS

The participants were selected using the targeted sampling method. The study involved the members of Multiple Sclerosis Society in Klaipeda. The goals and methods of the study were explained to the participants of the study and the consent form was signed. The participants who agreed to participate in the study were acquainted with the progress of the study and possible inconveniences. Four MS patients (three females and one male) participated in the study. The study participants filled in a compound questionnaire, which contained questions about the duration and the progress of the disease, potentially provocative factors and the currently experienced symptoms. Each participant answered the MSQOL-54 questionnaire prior the study [40]. The data were collected before WATSU Session 1 and after Sessions 5 and 10.

Inclusion criteria:

- Age: 20–60 years;
  - Progress of the disease: Relapsing - Remitting;
  - Patients with light and moderate levels of the diseases according to EDSS (Expanded Disability Status Scale) (1–6.5 points);
  - Experience of secondary fatigue;
  - Sleep disorders;
  - Frequent mood swings;
- Presence of at least mild depression;  
Low energy levels during the day.

Exclusions criteria: acute form of the disease; current treatment with experimental drugs.

The average age of participants was  $52 \pm 9.3$  years. Duration of the disease –  $11.5 \pm 5.6$  years. Disability level according to EDSS [41] was found  $4.2 \pm 1.5$ . All available medical records were reviewed in accordance with the rules on confidentiality and data protection and the demographic data were revised for the study. The identities of the participants were not disclosed. The participants were encoded using Roman numerals (I, II, III, IV). Two participants withdrew from the study due to the exacerbation of the disease. The criterion of gender distribution among the participants was not taken into account.

### RESEARCH DESIGN

Fatigue, sleep, quality of life, and the severity of depression were studied. All instruments and methods used in the study did not infringe intellectual property rights because their descriptions are publicly accessible on the Web. The following instruments were used:

Multiple Sclerosis Quality of Life questionnaire (MSQOL-54) [40]. This instrument was used to gain a better understanding of the patient's condition, well-being and health. The instrument consists of 54 questions: 36 general health-related questions address the health condition (physical condition, perception of own health, capacity, limitations due to physical conditions, sex life, social well-being and health disorders). The maximum score is 100. 18 specific questions address the mental condition (health disorders, general quality of life, emotional well-being, limitations due to emotional condition, and cognitive function). The maximum score is also 100.

Pittsburgh Sleep Quality Index [42]. This instrument was used to assess the quality of sleep. It consists of seven components to rate the subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each item is scored from 0 to 3 (0 = no problems, 3 = significant sleep disorders). The total PSQI score may range from 0 to 21. The higher the Index score, the lower is the quality of sleep. The total PSQI score above 5 indicates a deteriorating quality of sleep.

Burns Depression Checklist (BDC) [43]. The severity of depression was self-rated according to the Burns Depression Checklist, which is a reliable instrument to determine depression and to measure the severity of this disorder. The Burns Depression Checklist consists of four sections containing 25 items about thoughts and feelings, activities and personal relationship, physical symptoms (senses) and suicidal urges. Each item is scored from 0 to 4 (0 = not at all, 1 = somewhat, 2 = moderately, 3 = a lot, and 4 = extremely). The total score may range from 0 to 100. The severity of depression is determined according to the total score. 0–5 = no depression, 6–10 = normal but unhappy, 11–25 = mild depression, 25–50 = moderate depression, 51–75 = severe depression, 76–100 = extreme depression.

Fatigue Impact Scale (FIS) [44]. This scale was used to evaluate the impact of fatigue. It is a general type questionnaire consisting of 40 items that assess the fatigue in three aspects: physical, social and cognitive. Each item is scored from 0 to 4 (0 = no problems, 4 = significant problem). The total score may range from 0 to 160 scores. The higher is the total score, the stronger is the fatigue.

Expanded Disability Status Scale (EDSS) [41]. This instrument was used to quantify the overall disability in the participants of the study. The scoring was based on the examination by the neurologist. The total score of the scale may range from 0 (no disability) to 10 (death due to MS). The score ranging from 0 to 3.5 indicates that the patient is active and independent at home and at work; step 4 to 4.5 indicates the progress of the disease and limitations in the patient's life; step 6 to 7.5 indicates the loss of independence and required assistance from others; step 8 to 10 indicates the required support and total dependence on others.

## EXPERIMENTAL PROCEDURE

The study was carried out in the medical center in Klaipeda, Lithuania from 09-11-2019 till 18-01-2020. The study lasted for 10 weeks. Each participant of the study received ten WATSU

sessions. The sessions were delivered once a week, always at the same time before noon. One session lasted for 60 minutes. The sessions were delivered by a licensed physiotherapist. The sessions took place in a vertical bathtub of 1.45 m depth. The water temperature was maintained between 32-35°C. Room temperature was 26°C. WATSU floats were placed on the patient's legs to support the floating on the water. During the session the patient's face was always kept above water. To ensure the patient's safety, the WATSU physiotherapist held the patient on her arms throughout the entire session.

WATSU movements:

- Section I – Still point, Water Breath Dance, Offerings Simple/ One Leg/ Two Leg; Accordion; Rotating Accordion; Free Spine, Gate Hold; Explore Flow Simple/ Heart Gate/ Near Gate/ Far Gate; Free Arm; Distant Stillness; Seaweed; Seaweed Roll; Seaweed Rock; Hara Rise; Slide Up Back.
- Section II – WBD and Spiral Offering; Near and Far Leg Rotation; Back Opening; Arm Breath Squeeze; Hand Hold; Pull Around; Swing; Push Around; Arm Leg Rock I and II; Shoulder Rotation; Arm Play and Lift; Chest Opening; Back Lift Roll Hook; Thigh Press; Corner Spread; Hand Opening; Arm Back Around.
- Section III – Hara Rock; Hara Spiral; Turn and Pull; Sweep under Shoulder; Lengthening Spine; Twist Over; Sweep Around; Side Stroke; Spine Pull; Undulating Spine; Hip Tug; One Turn, Pull and Under Shoulder.
- Section IV – Side Saddle; Sandwich; Face Head Neck Shoulder Arm; Pulling Back (Bladder Meridian); Leg Roll and Lunge; Knee and Foot; Heel to Buttock; Head Lift; Twists; Sandwich; Explore Movement; Head on Heart; Heart Rock Completion [18].

The patient's condition was carefully monitored. The agreement with the patient provided for the possibility for the patient to withdraw in the event of any negative symptoms. The therapy was conducted in silence.

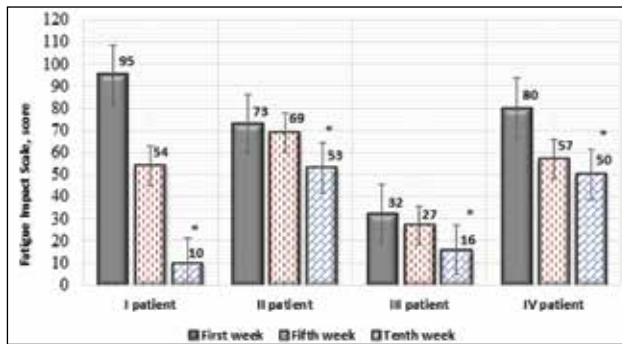
## ETHICAL CONSIDERATIONS

The research protocol was formally approved by the Ethics Committee of Klaipeda University, Faculty of Health Sciences, Holistic Medicine and Rehabilitation Department on 26th of September 2019. Good scientific practice was followed throughout the study (All European Academies [ALLEA] 2017). The ethical approval for the entire research project was received from the *Ethics Committee* of Klaipeda University. In addition, the approval from Medical centre was received. Permissions for using the instruments were received from their copyright holders. Before signing consents all participants received an information letter concerning the study, the voluntariness of participation, confidentiality and the right to withdraw at any stage of the study according to Helsinki Declaration.

## STATISTICAL ANALYSIS

The research data was processed using IBM SPSS Statistics 20 and Microsoft Office S Excel 16 software. The software was used to calculate arithmetic means, rates, standard deviations, and mean errors. The statistical data reliability was evaluated by using Student's T criterion (where  $p > 0.05$ )





**Figure 1.** The change of the participants' fatigue within the period of 10 weeks according to the Fatigue Impact Scale. Statistically significant \* $p \leq 0.05$

means the difference is statistically insignificant and  $p < 0.05$  means the difference is statistically significant). Qualitative Outcome Measures were conducted by content analysis, observation, semi-structured individual interview methods. Participants were asked to answer following questions right after their WATSU treatment: How was your experience being treated with WATSU? Which changes did you notice in response to your WATSU treatment? Which aspects of your WATSU treatment were less pleasant for you?

## RESULTS

### CHANGE IN FATIGUE

The fatigue of the study participants was rated according to the Fatigue Impact Scale (Figure 1). A higher level of fatigue causes more problems, it occurs more frequently and is very draining. Fatigue causes is a risk of depression or higher degree of depression, the sleep disorders and deteriorating quality of life.

### ASSESSMENT OF PATIENT I

Patient I was a female. Her fatigue score at the beginning of the study was 95 ( $70 \pm 26.94$ ) of 160. The comparison of the scores before and after the sessions revealed a statistically significant ( $p \leq 0.05$ ) reduction from 95 ( $70 \pm 26.94$ ) to 10 ( $34 \pm 24.42$ ). Out of four patients, Patient I reported the greatest reduction in fatigue level. During the interview about the feeling of fatigue, Patient I noted that she had felt more energetic during the week, that the feeling of fatigue was the most intense 1–2 hours after the WATSU session. Later the fatigue diminished and the energy boosted. After the first session she felt very tired and wanted to sleep. Upon return home she fell asleep and slept until the evening. On the next day she was more energetic than usual. Prior to the cycle of WATSU sessions the fatigue was one of the greatest problems, which the patient could not control except for pacing herself to save energy. After the WATSU sessions the mobility problem became less acute. After the sessions the patient did not have to limit her work load in order to save energy, her performance improved, her motivation to involve in more activities increased and she had to pace herself less in her physical activities. The duration of her physical activities also extended. Prior to the study the patient avoided stressful situations; now she can tackle them with more ease, she feels greater emotional stability. Before she felt muscle weakness

that caused fatigue; after the sessions the weakness was less frequent and was no longer an issue. The frequency of breaks for rest, which was an important issue ten weeks ago, had reduced and she did not name it as a problem. The feeling of blue has become less frequent, irritation and frequent attacks of anger have disappeared. Patient I can plan her time easier. Her self-esteem has increased, she enjoys cooking and experimenting, is eager to try new things. Her motivation in group work has increased, she can generate ideas and has energy to realize them, her performance has also improved.

### ASSESSMENT OF PATIENT II

The second patient was also a female. At the beginning of the study her fatigue score was 73 ( $70 \pm 26.94$ ) of 160. The difference between the fatigue scale scores before and after the WATSU sessions was 20. The decrease of the fatigue was not as significant as in the case of Patient I, however it was statistically significant ( $p \leq 0.05$ ). During the 10 weeks of the study the fatigue level was the highest 30 minutes after the session and in the first half of the day. In the evening the fatigue decreased, the patient was more energetic and in better mood reported as energy boosts. In the remaining days of the week the fatigue stabilized and did not increase. Answers to the questions of the FIS revealed Patient's II increased sensitivity, which was a serious issue before. The patient was able to increase the physical load, her performance level and motivation to participate in social activities increased. Her reasoning became faster, decision making and problem solving improved. She found it easier to concentrate on specific activities. The patient's agility and coordination improved, she needed minimum caution in performing physical activities and she was able to do physical activities longer. Before the study the patient named muscle weakness as a problem, which reduced after 10 weeks of WATSU sessions. During the study the limitations of physical activities decreased, breaks for rest were shorter and less frequent.

### ASSESSMENT OF PATIENT III

Patient III was a female. At the start of the study her fatigue score was 32 ( $70 \pm 26.94$ ) of 160. During 10 weeks of the study the FIS score decreased from 32 ( $70 \pm 26.94$ ) to 16 ( $34 \pm 24.42$ ). The score difference before and after the sessions was 16. This difference was the lowest among all participants, however statistically significant ( $p \leq 0.05$ ). The patient felt minimum fatigue after the sessions, she was happy and satisfied, felt a bit sleepy after the sessions, but later her energy level increased. Mobility was a minor problem to her and it disappeared after the study. Prior to the study her work load was limited due to the fatigue and the limitation decreased during the study. The patient's performance improved, she could plan her time better and maintain physical activity longer than before, her agility and coordination improved. The patient's emotions stabilized although she had not experienced serious mood fluctuations, irritation and anger attacks prior to the study.

### ASSESSMENT OF PATIENT IV

The fourth patient was a male. At the start of the study his fatigue score was 80 ( $70 \pm 26.94$ ) of 160. During the study the fatigue score dropped from 80 ( $70 \pm 26.94$ ) to 50 ( $34 \pm 24.42$ ).

The score difference of 30 is statistically significant ( $p \leq 0.05$ ) compared to the scores of Patient II and Patient III. The patient's mobility did not change much, however a slight improvement from 3 to 2 scores was observed during the study. Prior to the sessions, his daily work load had been reduced more than would be desirable, but during the study the workload the patient could bear gradually increased. The patient's performance improved and his motivation increased. The patient needs more efforts to finish the task that requires physical effort. Prior to the study, the patient's physical activity was limited and did not change after 10 weeks: coordination of movements was difficult, physical discomfort continues, he had to pace himself in his physical activities, saved energy and could not maintain physical activity for a longer time. The usual number of rest breaks did not decrease, but the breaks became shorter. It took less time for the patient to rest than before the study. After the sessions it was easier for the patient to concentrate and keep the attention longer. Decision making also became easier. The mood improved, the patient felt less irritated and anger attacks were seldom. He felt it easier to communicate with people and family members.

#### CHANGE IN THE QUALITY OF SLEEP

The scores of the Sleep Quality Index (Table 1) showed changes in the quality of sleep of all four patients. Individual scores of the Sleep Quality Index revealed a statistically significant ( $p \leq 0.05$ ) decrease, which means that the patients' quality of sleep improved. The greatest improvement was observed in Patient I and Patient II. The PSQI of Patient I reduced from 5 ( $5 \pm 0.82$ ) to 1 ( $3 \pm 1.83$ ), and from 4 ( $5 \pm 0.82$ ) to 2 ( $3 \pm 1.83$ ) in Patient II. The PSQI of Patient III and Patient IV also reduced, but not as much as of the first two patients. The PSQI of Patient III reduced by one score only. Prior to the study, Patient IV had the highest PSQI, which reduced during the study from 6 ( $5 \pm 0.82$ ) to 5 ( $3 \pm 1.83$ ). It should be noted that after the study the PSQI of all patients reduced indicating the improvement in the quality of sleep. The frequency of pain at night did not change after the WATSU sessions and remained once a week or less frequent. The patients' self-rated quality of sleep was good.

For Patient I the changes of all scores were statistically significant ( $p \leq 0.05$ ). Significant changes in the quality of sleep were observed during the 10 weeks of the study. The hours slept have not changed (usually the patient sleeps 8–9 hours), but the time of falling asleep shortened from 20 minutes (prior to the study) to approx. 5 minutes (after the sessions). Prior to the study there were three or more times

of waking up in the middle of the night or early morning during the week. In the month following the two months of WATSU sessions the patient did not wake up in the middle of the night or early morning. She stopped coughing at night. She sometimes felt too cold or too hot. She stopped having pain after the therapy. She felt more alert than before, had more energy and greater interest in new activities.

Patient's II sleep quality index also indicated a statistically significant ( $p \leq 0.05$ ) improvement (Table 1). The patient sleeps 8 hours during the night. The length of sleep did not change after the therapy. She wakes up with the alarm clock to go to work. Prior to the therapy sessions she had difficulties falling asleep longer than 30 minutes once a week or once in two weeks. This problem disappeared after 10 weeks of the therapy. Getting up to use the bathroom at night reduced from 3 or more times a week to once a week. Sometimes she had bad dreams before but in the last month of the therapy she did not have any bad dreams. Prior to the study she sometimes had pain at night but after the therapy she does not have any pains at night. The patient's self-rated quality of sleep was very good. Indifference and apathy to the environment decreased, the patient feels more energetic.

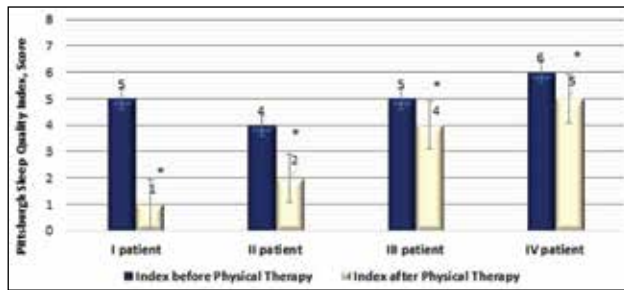
Patient III had a good sleep quality index score prior to the study, and after the study the total score reduced by one point only indicating an insignificant improvement in the quality of sleep. The change in the quality of sleep after the study is statistically significant ( $p \leq 0.05$ ). After the WATSU sessions the sleeping time of 8–9 hours did not change, however the time of falling asleep reduced from 20 to 15 minutes; however, there were a few times in a month the patient could not fall asleep longer than 30 minutes. Before the study she sometimes felt hot or cold, had bad dreams. After the therapy these problems disappeared. The patient used to have pain at night three times a week or more often. After the WATSU sessions the frequency of the pain decreased to once a week or no pain at all. The patient noted that after the sessions she remained alert for a longer time. She rated the quality of her sleep as good.

Patient IV had the highest PSQI score before the study, i.e. the lowest quality of sleep among all study participants. During the study the patient's PSQI score reduced to 5 and this difference is statistically significant (Figure 2). The sleeping time did not change after the therapy. Frequent wake-ups (3 or more times a week) at night remained. The wake-ups may be related to the need to use the bathroom. After the sessions the heavy breathing, which made it difficult for the patient to sleep at night before the study, became easier. The patient also coughed less. The patient also experienced episodes of cold and

**Table 1.** Pittsburgh Sleep Quality Index results. The higher the Index score means the lower is the quality of sleep

| Patient | Before research | Score | After Research | Score | Sleep Present      |
|---------|-----------------|-------|----------------|-------|--------------------|
| I       | 5               | =5    | 1              | <5    | Good Sleep quality |
| II      | 4               | <5    | 2              | <5    | Good Sleep quality |
| III     | 5               | =5    | 4              | <5    | Good Sleep quality |
| IV      | 6               | >5    | 5              | >5    | Bad Sleep quality  |





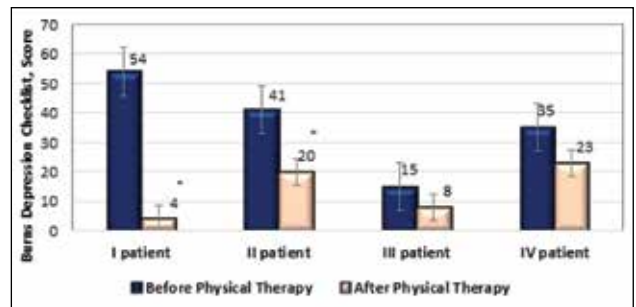
**Figure 2.** Results of the changes in the quality of sleep among the study participants according to the Pittsburgh Sleep Quality Index. Statistically significant  $*p \leq 0.05$

heat, sometimes had bad dreams. The feeling of cold or heat reduced and there were no bad dreams after the therapy.

**CHANGES IN DEPRESSION**

Observations were made whether the severity of depression in the study participants measured by Burns Depression Checklist changed along with the reduced fatigue during the ten weeks of the study (Figure 3). A statistically significant improvement in depression scores was observed in all study participants. The most significant change was observed in Patient I, who had the highest degree of depression before the study. The patient was diagnosed with depression as a comorbidity in MS. During the ten weeks of the study her depression severity reduced significantly from 54 (36.25±16.26) to 4 (13.75±9.18) scores (Table 2). Patient’s II results ranked second by the change in depression severity. The comparison of the checklist results before and after the WATSU sessions showed a difference of 19 scores and the depression severity changed from moderate to mild. Patient’s IV degree of depression measured according to Burns Depression Checklist reduced from 35 (36.25±16.26) to 23 (13.75±9.18) (Table II) and the severity changed from moderate to mild. Patient III had a mild degree of depression before the study and after the therapy the degree of depression reduced.

Patient I was the most emotional of all study participants. Mood and occupation were very important to her and these factors particularly affected the patient’s emotional state. The patient noted that after the therapy sessions she seldom experienced low mood. Her sensitivity, which provoked crying, has diminished, and the patient’s self-esteem has increased. Her interest in the family life and people around increased, she spends more time with people and does not feel so lonely any more. The patient’s interest in the immediate environment



**Figure 3.** The change in the degree of depression of the participants according to the Burns Depression Checklist before and after the study. A statistically significant ( $*p \leq 0.05$ ) improvement in depression scores was observed in all study participants

and motivation to engage in different activities increased. The feeling of satisfaction and joy of life has returned. Prior to the study the patient gave the highest score of 4 to severe and bothersome fatigue, sleep problems, loss of libido, and worrying a lot about her health. After the ten weeks of the therapy the patient had a 0 score for all the above symptoms. The patient reported that after the WATSU sessions her personal relations and activities improved and that even her friends and family had noticed positive changes.

Patient II. The comparison of the checks describing the symptoms in BDC inventory revealed that the biggest changes were in the items of the categories Thoughts and Feelings and Activities and Personal Relationships. After the therapy sessions the patient’s mood has improved, she seldom felt depressed and unhappy, she became less tearful and the crying spells have disappeared. The patient’s confidence and self-esteem have increased. She stopped feeling lonely and paid more attention to the family. He motivation to involve in different activities has increased. The patient reported that her fatigue had reduced, that she could fall asleep faster than before, her excessive anxiety about her health had diminished.

Patient III was happy, confident, and communicating well before and after the study. She had mild depression according to BDC results. The change in depression degree after the study was not significant, but still visible. Before the study, the patient sometimes felt unhappy, sad or was in low mood, sometimes she lacked confidence. After the study the symptoms have significantly reduced and became almost unnoticeable. Before the study the patient often felt lonely and these feelings have disappeared after the therapy. Health related anxiety has also diminished.

**Table 2.** Results of depression rating using Burns Depression Checklist

| Patient | Score before research | Evaluation          | Score after research | Evaluation         |
|---------|-----------------------|---------------------|----------------------|--------------------|
| I       | 54                    | Severe Depression   | 4                    | No Depression      |
| II      | 41                    | Moderate Depression | 20                   | Mild Depression    |
| III     | 15                    | Mild Depression     | 8                    | Normal but unhappy |
| IV      | 35                    | Moderate Depression | 23                   | Mild Depression    |

Patient IV had a moderate degree of depression according to the Burns Depression Checklist. After the study the total scores indicated moderate depression and at the end of the study the total score showed mild depression. Sometimes the patient had suicidal thoughts. The patient reported that after the therapy sessions he felt happier than before. The patient's confidence improved and the feeling of hopelessness diminished. The patient did not have any crying spells before the study. After the study he was more willing to spend time with friends and family, the feeling of loneliness has disappeared. Prior to the study, he often felt very tired. During the study, the fatigue became less intense, and the patient could fall asleep easier. The anxiety about his health also diminished as with the other three patients.

#### CHANGES IN THE QUALITY OF LIFE AND PAIN PERCEPTION

The self-rating of the quality of life showed the improvement between Week 1 and Week 10 of the study (Figure 4).

Patient I rated her quality of life after the study as very good. She felt that her health was much better after the therapy than a year ago. Daily activities that require a lot of energy remained limited. The activities of medium intensity became less limited, and the required breaks between activities became less frequent and shorter. During the participation in the study, the patient's working intervals extended, she works more than usual, the work requires less effort. Her mood was good during the 10 weeks of the study and the improved mood had a positive effect on the quality of life. The patient's physical and emotional condition improved her communication with family and friends. The pain has eased and did not have a negative effect on the quality of life during four weeks, her daily habits improved. During the weeks of the study the patient's sleep improved and the degree of depression diminished. The patient was almost satisfied with her sexual life. After the sessions her sexual drive increased. On the 10-point scale, where 1 is very bad and 10 is excellent, she rated her quality of life by 9 points (very good).

Patient II rated her health as good although she did not perceive significant changes in her health condition by comparing it a year ago and after the study, except for less frequent and less intensive fatigue and weakness as well as tremor after the therapy. The time required to do the work remained the same; however, the physical limitations experienced in certain jobs reduced. She became more emotionally stable in her job. Throughout the study the patient's physical and

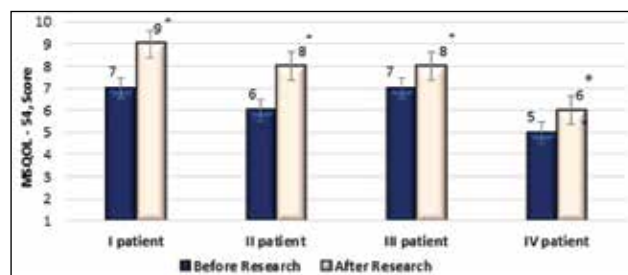
emotional condition did not hinder her communication with her colleagues, family and friends. During the four weeks of the study the patient felt only a light pain, which did not impact her job or housework. The patient reported that she had remained energetic for the larger part of the day. The patient started feeling exhausted later than before. The patient did not report any problems in her sexual life. The previously reported problems diminished during the study. According to patient, after the sessions her previous bowel and bladder problems no longer interfered with her social life. On the 10-point scale, where 1 is very bad and 10 is excellent, she rated her quality of life by 8 points (good).

Patient III rated her health condition as good and noted that some health aspects were rated better after the study than before the study. Before the study the patient's physical activity was not limited, but it was not intensive. She attempted to move more. Fatigue effected hew working day less. The patient's emotional condition did not have a negative effect on her daily activities. The patient's physical and emotional condition had no influence on her communication with family and friends. In the last four weeks the patient did not feel any pain and thus she could not assess the effect of pain on the quality of her life. Most of the day the patient felt energetic, was calm and happy. On the 10-point scale, where 1 is very bad and 10 is excellent, she rated her quality of life by 8 points (good).

Patient IV rated his health after the study better than before the study. However, the comparison of his health condition a year ago and now after the study showed almost no changes. All mobility related activities remained limited: dressing up took quite some time, home chores were difficult to cope with, climbing stairs was also difficult (the patient always uses a lift, where possible). The patient reported that his physical and emotional condition hindered his communication with the family and colleagues. During the four weeks of the study he felt a light pain that had little effect on the quality of his life. After the study the patient was more energetic, he felt well for most of the day; the fatigue occurred later. The patient felt the best in the morning. On the 10-point scale, where 1 is very bad and 10 is excellent, he rated his quality of life by 6 points (satisfactory).

#### DISCUSSION

The results of the study showed that the decrease in the level of fatigue in the participants was statistically significant ( $p \leq 0.05$ ). The tests revealed that a personalized program can ease the experienced fatigue irrespective of the disability level. Although the results are positive and significant, the benefit is short – term. Regular physiotherapy sessions are required for long – term improvements [45]. There is a proof of research that regular kinesiotherapy sessions reduce fatigue. Water is a good environment to reduce the patients' fatigue, therefore, aquatic activities are very helpful [46, 47]. Sakaliene R. recommends energy saving physical activities to combat fatigue. Heat exhaustion should be avoided in such activities. She advises to take longer breaks between the activities or more difficult tasks, to do the most difficult tasks in the morning, to priorities the tasks and to set realistic goals. Patients with chronic diseases must know the relaxation methods [48].



**Figure 4.** Results of Multiple Sclerosis Quality of Life questionnaire (MSQOL-54). Self-rated quality of life in a 10-point scale before and after the study. Statistically significant  $*p \leq 0.05$

The increased clinical implementation of WATSU in interdisciplinary treatment settings such as rehabilitation facilities indicates a growing acceptance of this body-based complementary therapeutic intervention. It is used as a component in multimodal treatment settings focusing on posttraumatic stress disorder, and anxiety [49, 50], chronic pain and fibromyalgia [4, 50], stress – related illnesses [51], depression [29, 50] and sexual dysfunction [52]. WATSU has also been recommended as a treatment for patients with hemiparesis, multiple sclerosis, cerebral palsy and spinal cord injury [1, 21].

Our test results also showed a statistically significant improvement in the quality of life of the study participants. The results of our study confirm the findings of other researchers studying the effect of WATSU therapy on psycho – emotional state indicators. Components of WATSU including gentle touch are believed to act in a stress reducing manner [53, 54]. Considering physiological effects on the cardiopulmonary system due to physical exposure to hydrostatic pressure, certain cardiac conditions, for example, chronic heart failure [55] and respiratory impairments such as cystic fibrosis [56] can be regarded as potential indications for this treatment. In addition, the therapist's thoroughly compassionate attitude allows her/him to enter a parasympathetic state that the patient is nonverbally encouraged to join in [57]. During immersion, patients experience decreased heart rates [55] that are organically anticipating and promoting a parasympathetic state of relaxation. Reduced hypothalamic – pituitary – adrenal axis activity, that is, lower plasma cortisol levels along with increased mental and physical relaxation in context with immersion, has previously been reported [58, 59]. A potential mode of action promoting emotional wellbeing might be the activation of afferent C – tactile fibers during immersion. It has been proposed that these fibers transmit slow gentle touch – analogous to bypassing water – that has been observed to activate emotional brain areas [60, 61]. According to expert opinion WATSU might be alleviating excessive muscle tone and pain due to rotational movements of the trunk and gentle rocking of the whole body, leading to dampened muscle tone as a side effect of vestibular system activation [27].

The evaluation of the severity of depression before and after the study showed a statistically significant decrease in depression degree. The results of the study on the effect of WATSU therapy on people with Multiple Sclerosis showed that the method reduces stress and pain, improves mood and psychological well – being, improves the quality of life. WATSU therapy is most often used for pregnant women, but it is also recommended for patients with neurological disorders, including patients with multiple sclerosis [24]. Positive mood changes and eased pain was observed in the assessment of the psychological wellbeing of all study participants. There were tears and laughter, deep relaxation and contemplation during the WATSU sessions in our study. Some patients even fell asleep and woke up only after they touched the ground with their feet at the end of the session. After the therapy sessions the patients appreciated their feeling well, relaxation, the time spent alone with their thoughts. The boost of emotions even caused tears of joy in some of them. Better patients' mood was the most

noticeable. There was a statistically significant decrease in the degree of depression, improvement in the quality of sleep and the quality of life. No exacerbation of multiple sclerosis was observed during the 10 – week study. The test results showed that additional health issues mentioned in the pre-study interview, such as back ache, restricted leg and hand movements, tension and too high muscle tone, also improved. Back aches significantly reduced and finally disappeared after the WATSU sessions. The restricted amplitude of broken limbs increased and the feeling of discomfort of the movement reduced. The tension of the body and too high muscle tone characteristic of multiple sclerosis also reduced after the therapy. WATSU sessions are based on a gentle physical contact with another human and this contact eases the feeling of social exclusions and pain. Touching as a therapy method is discussed with respect to sensory neurons, the pain threshold, which especially react to a soft touch influenced by speed of the therapeutic touch and the temperature. Warm water is believed to have a stimulating effect, although not proved scientifically. The efficiency and success of the WATSU therapy depends on the trust in the therapist, the patient's mood and attitude towards the therapy. Water makes an individual to focus on him/herself. The patient does not hear extraneous sounds, feels lightness and thus relaxes [62]. Every movement in the therapy echoes the patient's needs. The therapist selects different movements in response of the patient's body language. The movements and their sequence are different in each session. Sometimes many movement modulations are performed, while in other sessions the movements are simple and relaxing because the patient's body resists to certain movements. All participants of our study noted that they were not aware of the time and space, time passed unnoticed, they did not feel being in the water, any foreign stimuli and the touch of the therapist. The temperature of water during the therapy is very important. Cooler water causes stress and has a negative effect on the efficiency of the therapy. The patient cannot relax in the cool water, his/her body becomes tense and it is difficult for the therapist to perform the procedure. Our test results showed a statistically significant improvement in the quality of sleep. The participants of our study also reported the reduced pain and improved physical activity. The participants' mood and communication with friends and family improved due to the reduced degree of depression. All these factors had a positive effect on the quality of life, which the patients rated higher than before the study. The results of our study do not contradict to the findings of Plecash A.R. According to Plecash A.R. one of the most effective treatment methods for Multiple Sclerosis patients is physical therapy. Regular exercise and physical activity are important at all stages of life to prevent illness, to feel good and to support one's quality of life. The role of physical therapy varies throughout the illness course. In addition, in general interventions are aimed to help the patient achieve and maintain their optimal functional independence. The Multiple Sclerosis researches showed that physical activity is effective to improve the physical health, especially the strength of the muscles and the gait, as well as emotional health, especially by reducing fatigue [63].



## CONCLUSIONS

A statistically significant decrease in secondary fatigue was observed from the patients' self-rated data before and after the study. After the study, the total score of the Sleep Quality Index reduced with a statistical significance thus indicating the improved quality of sleep of the study participants.

The evaluation of the depression degree before and after the study showed a statistically significant decrease in depression degree: the severity of depression in all study participants changed to a milder form or disappeared. A statistically significant improvement of all indicators of the quality of life were observed in the progress of the ten-week study.

## PRACTICAL RECOMMENDATIONS

The results of our study have shown that the WATSU therapy can be very effective in improving the quality of life of people with multiple sclerosis by reducing pain and fatigue, and by facilitating patients' mobility. Therefore, the method could be effectively applied in rehabilitation practice to improve the motor functions and psycho-emotional condition of MS patients.

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**ADDRESS FOR CORRESPONDENCE:**

**Elvira Malysko**

Vilnius University

3 Universiteto g., 01513 Vilnius, Lithuania

e-mail: elvira.malysko@mfvu.lt

**ORCID ID and AUTHORS CONTRIBUTION**

0000-0001-6604-8742 – Julija Andrejeva (A, B, C, D)

0000-0003-0788-6441 – Elinga Mockute (B, C, D)

0000-0003-1932-4729 – Grazina Sniepiene (A, B)

0000-0003-2911-5146 – Elvira Malysko (C, D, E)

0000-0002-6562-053X – Natalja Istomina (C, D)

0000-0003-2585-3782 – Vaiva Hendrixson (D, E)

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

# Using Cytoprotective Features of Succinic Acid During the Rehabilitation of the Patients with Previous Acute Myocardial Infarction Complicated with Decompensated Heart Failure

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**Khrystyna V. Levandovska, Nataliia B. Tymochko, Tetiana V. Naluzhna**

Ivano-Frankivsk National Medical University, Ivano-Frankivsk, Ukraine

## SUMMARY

**Aim:** To improve treatment effectiveness for patients with previous myocardial infarction (MI) while studying clinical pathogenetic features of decompensated heart failure (HF) in the postinfarction period with the focus of using succinic acid.

**Materials and Methods:** The work is based on the results of an examination of 60 patients with previous MI, who got registered decompensated II A-B CHF. The patients with previous STEMI complicated by decompensated HF were divided into groups: the I group included the patients with previous STEMI, who were getting standard treatment according to the guidelines of the MoH of Ukraine (beta-blockers, ACE inhibitors, dual antiplatelet therapy (acetylsalicylic acid+clopidogrel), nitrates, statins) (n=30); the II group included the patients with previous STEMI, who were getting succinic acid into the therapy complex beside the standard treatment.

**Results:** We determined insignificant improvements in such symptoms, as angina, dyspnea, dizziness, and tiredness in the group of patients receiving standard treatment. Herewith using succinic acid reduced clinical signs of inadequate response to physical exercise significantly. Disregarding the one-sidedness of the probable dynamics of the aforementioned 6MWD characteristics, the positive dynamic was less significant in the case of standard treatment. All examined groups presented positive dynamics concerning decreasing the number of points in the patients with decompensated HF after STEMI during the therapy according to Borg's scale.

**Conclusions:** The use of succinic acid for patients with decompensated heart failure that occurred after STEMI is accompanied by positive clinical effects, and antiischemic and cytoprotective influence.

**Key words:** decompensated heart failure, myocardial infarction, six minute walk test, succinic acid

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## INTRODUCTION

Acute myocardial infarction is not only the most complicated manifestation of ischemic heart disease (IHD), but also one of the main causes of mortality and physical incapacity, especially in elderly people [1].

Our understanding of causes, diagnostics, and treatment of acute MI has developed significantly in the last 40 years. At the beginning of the 20th century, it was considered a lethal case diagnosed only after an autopsy [2, 3]. Despite significant progress in the treatment of ischemic heart disease, acute MI remains the main cause of the onset of heart failure and its further decompensation.

There are three variants of it according to the continuity of its development: the beginning of HF during MI; the development of HF during hospitalization due to MI, and after the release from the hospital [4]. HF and its decompensation in patients with previous acute MI has a significant influence on the final state of the patient and increases general mortality risk by three times, and cardiovascular mortality rate by four times [5]. The time of onset and decompensation of HF is significant too. So, HF developed more than 3 days

after acute MI is connected to a 43% higher mortality rate compared to the patients, in whom this syndrome developed during the first 3 days after MI [6, 7]. The development of HF and its decompensation is extremely widespread in 30 days after acute MI, it is diagnosed in 13%, and in 20-30% in a year after the release [8].

In the GRACE score, the Killip class became the most important harbinger of mortality compared to the patients without HF signs: rales were observed 2 times, pulmonary edema 3 times, and cardiogenic shock 4 times more often [9].

According to the World Health Organization's definition from 1964, cardiologic rehabilitation includes all actions done to provide an optimal physical, psychic and social environment for a cardiologic patient to allow him or her restoring maximal functionality [10].

As a science, cardiology has come a long way in the last few decades to understand, treat, and rehabilitate patients had suffered from acute MI. But the search for new medications and rehabilitation procedures to improve the postinfarction period of the patients is remaining open [11]. High morbidity,



mortality, and risk of recurrent hospitalizations due to decompensated HF in the postinfarction period lead to the search for new diagnostic methods, stratification, and especially the treatment of such patients contingent [12, 13]. During the complex treatment of patients with IHD, it is necessary to use metabolic medications that improve oxygen uptake efficiency by ischemic myocardium [14]. Among synthetic myocardial protectors, the group of 3-oxypyridine derivatives draws attention. A characteristic of these medicines is their possibility to strengthen energy-saving and energy-synthesizing functions of cells while not influencing central hemodynamics, and protecting cardiomyocytes in this way.

**AIM**

To improve treatment efficacy of the patients with previous MI, while studying clinical and pathogenetic characteristics of decompensated HF in the postinfarction period with the focus of using succinic acid.

**MATERIALS AND METHODS**

The work is based on the results of an examination of 60 patients with previous MI, who got registered decompensated II A-B CHF according to V. Kh. Vasylenko and M. D. Strazhesko, FC III-IV (according to the NYHA). The inclusion criteria were STEMI not earlier than 24-28 days before the start of the study, complicated in the postinfarction period by decompensated HF.

The study did not include patients with acute and chronic cardiovascular inflammatory diseases, severe disorders of heart rate and conduction, stroke and transient ischemic attack in anamnesis, severe renal failure, and with high bleeding risk.

The patients with previous STEMI complicated by decompensated HF were divided into groups: the I group included the patients with previous STEMI, who were getting standard treatment according to the guidelines of the MoH of Ukraine (beta-blockers, ACE inhibitors, dual antiplatelet therapy (acetylsalicylic acid+clopidogrel), nitrates, statins) (n=30); the II group included the patients with previous STEMI, who were getting succinic acid into the therapy complex beside the standard treatment: 100 mg intravenously as drip infusion 3 times per day (for 5 days), 100 mg intramuscularly 3 times per day (from 6th to 14th day), then changing the intake of the medication 100 mg (1 capsule) orally 3 times per day from 15th day to 2 months of the therapy (n=30). Clinical evaluation of the patients' objective state was performed by studying activity and contractile ability indices of the heart, systolic and diastolic blood pressure levels, results of physical examination (orthopnea, gallop rhythm), cardiac asthma symptoms, congestion in the lungs, signs of peripheral edema. To determine a CHF functional class and to evaluate tolerance to physical exercise and treatment and rehabilitation measures efficiency, we performed the six-minute walk test (6MWT).

**Table 1.** Clinical signs in with previous STEMI and decompensated heart failure during physical activity

| Group of patients<br>Sign (points) | Standard treatment (n=30) |               |               | Standard treatment + succinic acid (n=30) |                         |                        |
|------------------------------------|---------------------------|---------------|---------------|---|-------------------------|------------------------|
|                                    | Before treatment          | 1 month       | 2 months      | Before treatment                          | 1 month                 | 2 months               |
| ST interval depression             | 18<br>(60.0%)             | 16<br>(53.3%) | 10<br>(33.3%) | 16<br>(53.3%)                             | 10<br>(33.3%)<br>p>0.05 | 2<br>(6.7%)<br>p>0.05  |
| Rhythm disorder                    | 20<br>(66.7%)             | 16<br>(53.3%) | 14<br>(46.7%) | 18<br>(60.0%)                             | 6<br>(20.0%)<br>p>0.05  | 4<br>(13.3%)<br>p>0.05 |
| Angina                             | 18<br>(60.0%)             | 14<br>(46.7%) | 12<br>(40.0%) | 18<br>(60.0%)                             | 6<br>(20.0%)<br>p>0.05  | 4<br>(13.3%)<br>p>0.05 |
| Dyspnea                            | 22<br>(73.3%)             | 20<br>(66.7%) | 14<br>(46.7%) | 20<br>(66.7%)                             | 8<br>(26.7%)<br>p>0.05  | 6<br>(20.0%)<br>p>0.05 |
| Dizziness                          | 24<br>(80.0%)             | 12<br>(40.0%) | 10<br>(33.3%) | 28<br>(93.3%)                             | 6<br>(20.0%)<br>p>0.05  | 2<br>(6.7%)<br>p>0.05  |
| Tiredness                          | 22<br>(73.3%)             | 20<br>(66.7%) | 18<br>(60.0%) | 22<br>(73.3%)                             | 8<br>(26.7%)<br>p>0.05  | 4<br>(13.3%)<br>p>0.05 |
| Cyanosis/paleness                  | 22<br>(73.3%)             | 20<br>(66.7%) | 16<br>(53.3%) | 18<br>(60.0%)                             | 10<br>(33.3%)<br>p>0.05 | 8<br>(26.7%)<br>p>0.05 |

Note: 1. The percentage from the total number of patients is noted in brackets. 2. p is the probability of the changes regarding the normal indices, the probability of the difference from the indices before treatment.

## RESULTS

The 6MWT was being done in the morning, in the 30-50 m hospital passage. Before the testing, the patient had breakfast, did not take cardiologic medications, did not smoke, and limited physical activity 2 hours before performing the test. Before the walking, heart rate, BP, and ECG in 12 standard leads were registered. Contraindications against testing with dosed physical exercise were unstable angina, MI during a month, uncontrolled angina or arterial hypertension (SBP > 180 mmHg, DBP > 120 mmHg), heart rate < less than 50 or > 120 bpm, musculoskeletal diseases, other diseases, which course can worsen due to the physical exercise. According to the results of testing, we measured the covered distance during 6 minutes in meters (6MWD – 6 Minute Walking Distance) and compare it to the normal index (6MWD n). After the loading test, the patient filled out the Borg rating of perceived exertion scale.

While analyzing the dynamics of the clinical signs during physical exercise in the patients with previous MI (Table 1), we determined insignificant improvements in such symptoms, as angina, dyspnea, dizziness, and tiredness in the group of patients receiving standard treatment.

After 2 months of the therapy, they were observed in 40%, 46.7%, 33.3%, and 60.0% of the examined patients.

ST depression and rhythm disorders were present in 33.3% and 46.7% of patients from this group.

Herewith using succinic acid reduced clinical signs of inadequate response to physical exercise significantly.

So, ST depression and rhythm disorders were seen in 6.7% and 13.3% of patients, who were getting succinic acid. Dyspnea, dizziness, and tiredness during the 6MWD were

**Table 2.** The dynamics of 6MWD signs in the patients with previous STEMI and decompensated heart failure

| Group of patients<br>Sign (points)                | Standard treatment (n=30) |                                   |  | Standard treatment + succinic acid (n=30) |                                   |  |
|---|---------------------------|-----------------------------------|--|---|-----------------------------------|--|
|   | Before<br>treatment       | 1 month                           | 2 months                               | Before<br>treatment                       | 1 month                           | 2 months                               |
| Covered distance, m                               | 173.87<br>±2.03           | 316.20<br>±4.72<br>p1*<br>Δ+81.86 | 346.53<br>±3.58<br>p1*, p2*<br>Δ+99.30 | 175.73<br>±3.45                           | 329.40<br>±5.65<br>p1*<br>Δ+87.45 | 352.60<br>±3.7<br>p1*, p2*<br>Δ+100.65 |
| Heart rate at rest, bpm                           | 88.13<br>±3.25            | 79.53<br>±3.81<br>p1*<br>Δ-9.75   | 70.60<br>±2.23<br>p1*, p2*<br>Δ-19.89  | 87.60<br>±3.64                            | 73.07<br>±1.58<br>p1*<br>Δ-15.62  | 67.13<br>±2.42<br>p1*, p2*<br>Δ-23.37  |
| Heart rate after exercise, bpm                    | 105.47<br>±2.50           | 85.27<br>±3.53<br>p1*<br>Δ-19.15  | 81.47<br>±3.16<br>p1*, p2*<br>Δ-22.76  | 105.47<br>±3.18                           | 81.27<br>±2.81<br>p1*<br>Δ-22.94  | 78.87<br>±1.88<br>p1*, p2*<br>Δ-25.22  |
| SBP at rest, mmHg                                 | 157.07<br>±7.33           | 144.20<br>±3.45<br>p1*<br>Δ-8.19  | 140.00<br>±2.98<br>p1*, p2*<br>Δ-10.87 | 156.93<br>±6.53                           | 141.00<br>±2.14<br>p1*<br>Δ-10.15 | 138.80<br>±1.97<br>p1*, p2*<br>Δ-11.55 |
| SBP after the exercise, mmHg                      | 181.33<br>±6.11           | 168.67<br>±5.16<br>p1*<br>Δ-6.98  | 157.33<br>±5.3<br>p1*, p2*<br>Δ-13.24  | 176.60<br>±5.91                           | 160.33<br>±3.24<br>p1*<br>Δ-9.21  | 153.80<br>±2.31<br>p1*, p2*<br>Δ-12.91 |
| DBP at rest, mmHg                                 | 92.73<br>±1.62            | 89.20<br>±2.24<br>p1*<br>Δ-3.80   | 86.87<br>±2.26<br>p1*, p2*<br>Δ-6.32   | 92.93<br>±1.58                            | 87.27<br>±1.87<br>p1*<br>Δ-6.09   | 82.27<br>±2.89<br>p1*, p2*<br>Δ-11.47  |
| DBP after the exercise, mmHg                      | 103.27<br>±1.44           | 95.73<br>±2.08<br>p1*<br>Δ-7.30   | 92.13<br>±1.77<br>p1*, p2*<br>Δ-10.79  | 103.00<br>±1.81                           | 92.33<br>±2.44<br>p1*<br>Δ-10.36  | 90.13<br>±2.67<br>p1*, p2*<br>Δ-12.54  |
| O <sub>2</sub> consumption, mL/min/m <sup>2</sup> | 11.58<br>±0.11            | 13.34<br>±0.26<br>p1*<br>Δ+15.27  | 14.59<br>±0.30<br>p1*, p2*<br>Δ+25.99  | 11.58<br>±0.13                            | 15.33<br>±0.43<br>p1*<br>Δ+32.38  | 16.44<br>±0.35<br>p1*, p2*<br>Δ+41.97  |

Note. The probability of the difference: p1 compared to the values before treatment, p2 compared to the indices in 1 month of treatment, \* is  $p < 0.05$ , \*\* is  $p > 0.05$ ; Δ is the increase or decrease (-) of an index during the treatment in percents compared to values before the treatment.

observed in 20.0%, 6.7%, and 13.3% of patients from the second group. Similar regularities were present in the dynamics of cyanosis/paleness.

So, the signs of the insufficiency of peripheral perfusion in the group of patients receiving standard therapy decreased from 73.3% before the treatment to 53.3% after the 2 months of therapy; while using succinic acid, it decreased from 60.0% to 26.7%.

The therapy with succinic acid helped to reduce clinical signs of inadequate response to dosed physical exercise.

For example, dyspnea that accompanied physical exercise in 73.3% and 60.0% of the patients of both groups at the beginning of the treatment reduced after 2 months of treatment and remained only in a third of the examined patients, in 46.7% and 20.0% respectively.

Similar regularities were in the dynamics of angina, dizziness, cyanosis/paleness, and tiredness.

The authors analyzed the influence of the therapy on the examined patients' 6MWD.

So, before treatment, the patients from the first group covered a distance of (173.87±2.03) m on average, after a month of the standard therapy the distance increased to (316.20±4.72) m ( $p<0.05$ ), and after 2 months to (346.53±3.58) m ( $p<0.05$ ). The treatment of the patients from the II group with succinic acid besides the standard therapy contributed to a probable effective increase of the average distance, which a patient covered, by 100.65%. So, the average distance value in patients from this group was (175.73±3.45) m before the treatment and increased to (352.60±3.7) m ( $p<0.05$ ).

During 2 months of the treatment, we ascertained increased tolerance to physical exercise and improved working capacity by the patients (Table 2).

According to the received results, after 1 as well as after 2 months of observing, all groups of patients presented probable ( $p<0.05$ ) lower indices of heart rate, SBP, and DBP as in the rest, as well as after a performed exercise.

But in the case of the standard treatment, this positive dynamic was less significant than in the group of patients, where succinic acid was used besides the basic treatment. Heart rate in such patients increased from (88.13±3.25) bpm to (105.47±2.50) bpm ( $p<0.05$ ) (at the peak of exercise) at the beginning of the therapy.

After 2 months these values were (70.60±2.23) bpm and (81.47±3.16) bpm ( $p<0.05$ ) respectively.

Generally, the authors noticed decreased heart rate at rest and significantly lower growth in it during an exercise in the group of patients receiving the studied medication; the heart rate was (87.60±3.64) bpm at the beginning of the therapy and (67.13±2.42) bpm after its finish.

In this group of examined patients, SBP levels were (138.80±1.97) mmHg ( $p<0.05$ ) at rest and increased to (153.80±2.31) mmHg ( $p<0.05$ ) at the peak of exercise; and DBP was increasing from (82.27±2.89) mmHg ( $p<0.05$ ) to (90.13±2.67) mmHg ( $p<0.05$ ).

O<sub>2</sub> consumption levels were (11.58±0.11) mL/min/m<sup>2</sup> before the start of treatment and increased probably by 25.99% after it.

In the group of patients who received succinic acid this value was (11.58±0.13) mL/min/m<sup>2</sup> and increased by 32.38% and 41.97% after 1 and 2 months of the therapy. On the first and especially on the second treatment month, the 6MWD was accompanied by probably ( $p<0.05$ ) lower index of heart rate, SBP, and DBP as at the starting state, as well as after the exercise.

At the same time, disregarding the one-sidedness of the probable dynamics of the aforementioned 6MWD characteristics, the positive dynamic was less significant in the case of standard treatment.

So, the patients from this group presented heart rate (87.87±3.34) bpm at rest and (105.40±3.07) bpm after the exercise; as well as (74.00±3.34) bpm ( $p<0.05$ ) and (81.33±3.01) bpm ( $p<0.05$ ) respectively after 2 months treatment.

Similar regularities in heart rate response to the exercise were observed during the treatment of another group.

Table 3 presents the dynamics of individual perceived physical exertion according to the Borg's scale in the patients with previous STEMI and decompensated heart failure during the treatment with proposed medication schemes.

According to this table, all examined groups presented positive dynamics concerning decreasing the number of points in the patients with decompensated HF after STEMI during the therapy according to Borg's scale.

The patients, who were receiving the standard treatment, evaluated tiredness, perceiving exertion, dyspnea, and chest pain as (8.27±0.70), (3.73±0.80), (3.47±0.52), and (3.46±0.51) points before treatment, and as (5.33±0.72), (2.53±0.83), (2.60±1.12), and (2.13±2.07) points after the finish of treatment respectively ( $p<0.05$ ).

The patients from the II group evaluated the aforementioned signs as (8.93±0.88), (4.13±0.74), (3.47±0.52), and (3.47±0.67), (2.00±0.94), (1.60±0.63), and (1.67±0.69) points after 2 months therapy ( $p<0.05$ ).

In the group of patients, who were receiving the standard therapy, presented the number of points according to Borg's scale was (18.20±0.68) points before treatment and decreased to (14.47±0.74) points after the two months of therapy ( $p<0.05$ ).

The patients from the II group, who were administered succinic acid into the treatment complex beside the standard therapy, presented the average number of points (17.67±0.62) before the treatment and probably decreased to (13.27±1.22) points after 2 months under the influence of the therapy.

## DISCUSSION

From the point of view of evidence-based medicine, we reached significant success in the treatment of CHF, as well as its decompensation. The main therapy methods for this pathological state are inotropic stimulation of the myocardium and hemodynamic and neurohumoral unloading of the heart [14].

**Table 3.** Borg rating of perceived exertion scale (RPE scale) in the patients with previous STEMI and decompensated heart failure

| Group of patients<br>Sign (points) | Standard treatment (n=30) |                                  |                                       | Standard treatment + succinic acid (n=30) |                                  |                                       |
|------------------------------------|---------------------------|----------------------------------|---------------------------------------|---|----------------------------------|---------------------------------------|
|                                    | Before<br>treatment       | 1 month                          | 2 months                              | Before<br>treatment                       | 1 month                          | 2 months                              |
| Tiredness                          | 8.27<br>±0.70             | 6.47<br>±0.52<br>p1*<br>Δ-21.77  | 5.33<br>±0.72<br>p1*, p2*<br>Δ-35.55  | 8.93<br>±0.88                             | 5.40<br>±0.63<br>p1*<br>Δ-39.53  | 3.47<br>±0.67<br>p1*, p2*<br>Δ-61.14  |
| Perceiving exertion                | 3.73<br>±0.80             | 3.27<br>±0.70<br>p1**<br>Δ-12.33 | 2.53<br>±0.83<br>p1*, p2*<br>Δ-32.17  | 4.13<br>±0.74                             | 3.13<br>±0.83<br>p1*<br>Δ-24.21  | 2.00<br>±0.94<br>p1*, p2*<br>Δ-51.57  |
| Dyspnea                            | 3.47<br>±0.52             | 2.73<br>±0.70<br>p1*<br>Δ-21.33  | 2.60<br>±1.12<br>p1*, p2**<br>Δ-25.07 | 3.47<br>±0.52                             | 2.60<br>±0.64<br>p1*<br>Δ-25.07  | 1.60<br>±0.63<br>p1*, p2*<br>Δ-53.89  |
| Chest pain                         | 3.46<br>±0.51             | 2.93<br>±0.59<br>p1*<br>Δ-15.32  | 2.13<br>±2.07<br>p1*, p2*<br>Δ-38.44  | 3.47<br>±0.52                             | 2.53<br>±0.52<br>p1*<br>Δ-27.09  | 1.67±<br>0.69<br>p1*, p2*<br>Δ-51.87  |
| Total points                       | 18.20<br>±0.68            | 16.40<br>±0.83<br>p1*<br>Δ-9.89  | 14.47<br>±0.74<br>p1*, p2*<br>Δ-20.49 | 17.67<br>±0.62                            | 15.60<br>±0.91<br>p1*<br>Δ-11.71 | 13.27<br>±1.22<br>p1*, p2*<br>Δ-24.90 |

Note. The probability of the difference: p1 compared to the values before treatment, p2 compared to the indices in 1 month of treatment, \* is  $p < 0.05$ , \*\* is  $p > 0.05$ ; Δ is the increase or decrease (-) of an index during the treatment in percents compared to values before the treatment.

Determined by international standards pharmacotherapy of patients with LV EF < 40% is oriented to minimizing or eliminating clinical symptoms of CHF decompensation, improving quality and prolonging life expectancy for such patients, and carries in itself long-term intake of angiotensin-converting-enzyme inhibitors (ACE inhibitors) or sartans at their intolerance, beta-blockers, antimineralocorticoids, diuretics, and in some clinical situations ivabradine and digoxin [15].

Regardless of the permanent use of aforementioned medications, the clinical prognosis in such patients remains negative: mortality rate is 75% for 5 years from the moment of diagnosing, moreover up to 50% of patients need inpatient treatment due to the decompensation of their state [16, 17]. In such medical areas as oncology and immunology, therapeutic intrusions on the cellular metabolism level started to be used at the level of preclinical studies.

The focus is that the heart is one of the main energy-consuming organs in the body, adjuvant therapy, which is directed at increasing energetic metabolism, has cytoprotective and adaptive capability, decreases endothelial dysfunction, and has a great potency [18]. The dilemma of metabolic therapy consists in that from one side the evidence base for improving prognosis by using these medications is practically absent, and from the other side, the physicians register clear clinical effects regarding symptoms of several diseases caused by chronic hypoxia and ischemia [19]. The adequate energy supply of the pumping function

of the heart in its wide activity range from the rest state to its stress peak depends on the coronary reserve. The energy metabolism in the myocardium represents the relationship between the mechanisms of oxygen delivery and its disposal by cardiocyte subcellular structures namely mitochondria [20].

General cytoprotection while influencing processes of energy formation, transportation, and disposal aims to prevent death and destruction of cardiomyocyte structure in conditions of ischemia and reperfusion [21]. Precisely for these reasons, using the means having antiischemic, membrane stabilizing, and antioxidant features is advisable for patients with decompensated HF in the postinfarction period.

## CONCLUSIONS

The level of improving tolerance to physical exertion after the previous myocardial infarction depends not only on the duration of recovery treatment and rehabilitation measures but also on the presence of decompensated heart failure.

The use of succinic acid for patients with decompensated heart failure that occurred after STEMI is accompanied by positive clinical effects, and antiischemic and cytoprotective influence.

The use of this medication improves patients' clinical state, and decreases heart failure functional class, which is manifested in patients' increased capacity to cover twice longer distances during 6 minutes increasing capacity, and improved individual perceived exertion.

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### Conflict of interest:

The Authors declare no conflict of interest

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### ADDRESS FOR CORRESPONDENCE:

**Khrystyna V. Levandovska**

Ivano-Frankivsk National Medical University  
24 Serpnia St, 76000 Ivano-Frankivsk, Ukraine  
phone: +380992350445  
e-mail: levandovska87@ukr.net

### ORCID ID and AUTHORS CONTRIBUTION

0000-0003-3259-7940 – Khrystyna V. Levandovska (A, B, C, D)  
0000-0002-5319-5468 – Natalya B. Tymochko (A, E, F)  
0000-0003-0840-5355 – Tetiana V. Naluzhna (A,C, D)

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



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# Determinants for Predicting Polyorganic Functional Changes of the Musculoskeletal System in Children with Various Degrees of Joints Hypermobility

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**Yuliia Tonkopei<sup>1</sup>, Olha Skyba<sup>2</sup>, Viktor Bondarenko<sup>3</sup>, Tetiana Buhaienko<sup>2</sup>, Yurii Kurnyshev<sup>4</sup>, Tetiana Liasota<sup>5</sup>**

<sup>1</sup>Department of Public Health and Biomedical Foundations of Physical Culture, Sumy State Pedagogical University named after A.S. Makarenko, Sumy, Ukraine

<sup>2</sup>Department of Health, Physical Therapy, Rehabilitation and Ergotherapy, Sumy State Pedagogical University named after A.S. Makarenko, Sumy, Ukraine

<sup>3</sup>Department of English Language Practice, Sumy State Pedagogical University named after A.S. Makarenko, Sumy, Ukraine

<sup>4</sup>Department of Physical Culture and Basics of Health Studies, Yuriy Fedkovych Chernivtsi National University, Chernivtsi, Ukraine

<sup>5</sup>Department of Theory and Methods of Physical Education and Sports, Yuriy Fedkovych Chernivtsi National University, Chernivtsi, Ukraine

## SUMMARY

**Aim:** The aim of the work was to study the presence of determinants for predicting the local structures involvement of the musculoskeletal system against the background of joint hypermobility in children.

**Materials and Methods:** The study involved 446 children aged from four to six years. The study plan includes: copying the data of a comprehensive medical examination; determination of joint hypermobility by goniometry and evaluation according to the criteria of presence and degree of joint hypermobility by the method of C. Carter, J. Wilkinson – in the modification of P. Beighton; application of clinical and physiological methods (functional testing, genealogical analysis) and methods of mathematical data processing.

**Results:** The significance hierarchy of morpho-functional features in relation to the further development of the pathological process in children with one of the main manifestations of undifferentiated connective tissue dysplasia – joint hypermobility – is predicted. Determinants of predicting local involvement of musculoskeletal structures (mobility of the spine in the sagittal plane, muscles endurance of the dorsal torso surface) were determined.

**Conclusions:** Against the background of the study of a wide range of clinical features of several generations' orthopaedic lesions, the fact of highly-progressing risk of scoliotic disease and flat foot was established.

**Key words:** joints hypermobility, musculoskeletal system, morpho-functional state, genealogical anamnesis, forecasting

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## INTRODUCTION

The world community has long faced the task of children health improvement. Despite the innovative methods and tools involved into clinical and laboratory research and diagnostic equipment, there is a tendency to increase chronic pathology, including negative changes in the morpho-functional development of the younger generation [1-4].

The analysis of medical statistics accentuates the problem of the spread of musculoskeletal disorders in children. A number of professional studies in the field of paediatrics, orthopaedics, hygiene, physiology and genetics focus on a set of multiorgan disorders on the tissue, organogenic and organismal levels. Such changes are observed in 75% of children with musculoskeletal disorders [18, 22-24].

The combination of the main and secondary features in children diagnoses the appearances of undifferentiated

connective tissue dysplasia (UCTD) caused by the inferiority of collagen synthesis starting from the embryonic development and has a mesenchymal origin, working as an integrative system [5].

Due to the fact that the first stages of diagnostic of these changes can successfully be performed in the neonatal period, a special risk group of disorders in musculoskeletal system includes children older than three years, when the gradual stabilization of connective tissue structure enables the orthopedic monitoring of their morpho-functional development [24].

Numerous studies suggest that one of the main features of undifferentiated connective tissue dysplasia is the joints hypermobility (JHM), which is characterized by an increased amplitude of motion as the result of hereditary defect of collagen fibres [6].



The facts about the importance of the joints hypermobility in the clinical diseases anamneses of children musculoskeletal system are of particular relevance. Moreover, HMJ is difficult to register in children during their first year, and only after the age of two the constitutional features of joint mobility can be determined [10]. Normally, HMJ compensation has an intensive course at the age of 3 years, when there is a gradual decrease in the appearances of physiological HMJ against the background of collagen structure stabilization [21], which leads to increased stiffness of connective tissue components [12, 17].

It is a general knowledge that in children with varying degrees of HMJ on the background of UCTD there is a distinguished polymorphism of clinical and morphological disorders [13]. At the same time, morphological changes are mostly stereotypical and cause secondary disorders of organs and systems [7].

One of the main conditions for early prevention of orthopaedic pathology complications is to determine the priority symptomatic complexes of morpho-functional changes of the musculoskeletal system, considering their genetic aspect [8, 15, 16, 19].

The profound analysis of phenotypic traits characterizing the morphofunctional state of children body with the joints hypermobility is an important condition of the hierarchy of a complex prognosis of optimistic preservation of health in younger generation [9, 11, 12].

Thus, the identification of several causes influencing the formation and process of orthopaedic appearances in children during embryogenesis and ontogenesis [25], will allow to adequately choose a number of accompanying preventive and remedial measures for prevention and correction of typical orthopaedic pathology in children.

### AIM

The aim of the work is to study the presence of determinants for predicting the involvement of local structures of the musculoskeletal system against the background of joint hypermobility in children.

### MATERIALS AND METHODS

The study involved 446 children aged 4 to 6 years (196 of boys and 250 of girls). The study plan included: 1) copying the data of a complex medical examination; 2) determination of joint hypermobility by goniometry and further assessment by the criteria of presence and degree of joint hypermobility by C. Carter, J. Wilkinson – modified by P. Beighton using a medical goniometer [3].

As components of the criterion, passive bending of both thumbs to the forearm, passive reubending of the little fingers by 90°, elbow bending by 10°, knee flexion by 10° and touching the floor during bending forward with unbent knee joints, where each feature is estimated by 1 point. The number of points 0-2 indicated the absence of joints hypermobility, 3-4 points – its mild degree, 5-8 – severe degree of joints hypermobility, 9 points – a generalized form (severe degree) of joints hypermobility.

The anthropometric examination of children involved the use of classical methods and standard tools. The basic method

was used to determine the functional parameters of the children musculoskeletal system (determination of muscles strength endurance of the torso dorsal and ventral surface and spine mobility in the sagittal and frontal planes) [20].

Moreover, to assess the impact of endogenous factors on the severity of JHM in children, the information was being collected in obstetric history, information on pregnancy, child's neonatal period and development in later period according to a specially developed protocol of clinical and genetic examination.

According to the calculating method of the risk of dependence of population characteristics (disorder rate among children with JHM of various degrees and their relatives) on the influence of genetic factors, the transition from quantitative variables to binary values was performed. Initially, the data were distributed according to the principle of "case-control research", the next step was to calculate the relative risk:

$$RR = \frac{IR_i}{IR_o} = \frac{A_i \div R_i}{A_o \div R_o}$$

where RR (number of cases) – relative risk;  $IR_i$  and  $IR_o$  are disorder rates,  $A_i$  and  $A_o$  are the number of cases, and  $R_i$  and  $R_o$  are quantitative risk indicators for the exposed and unexposed selection.

The main part of the mathematical processing was performed with the help of standard statistical package STATISTICA 8.0. Mathematical processing of numerical data was performed by methods of variation statistics [14]. Differences between independent selection of children in cases of comparison of their average value, distributed according to the normal law, were estimated by Student's parametric criterion (groups of subjects were selected from the general population, the selections are representative).

Besides, for all selections, the correspondence of the empirical distributions to the normal law (Gaussian distribution) was assessed according to the Kolmogorov-Smirnov criterion. The differences probability was assessed by the significance level (p) at the level of  $p < 0.05$ .

With the help of discriminant analysis, the prognosis of functional changes of the musculoskeletal system among children with joints hypermobility was carried out, informative variables which can influence the further flow of complications of the musculoskeletal system against joints hypermobility were defined and classification functions with specificity and sensitivity indicator to each variant of result separately were estimated.

The research was performed according to the World Medical Associations Declaration of Helsinki and Council of Europe Protocol of the Convention on Human Rights and Biomedicine, approved by the Ethics Committee of Sumy State Pedagogical University named after A.S. Makarenko. The written consent was obtained from all the parents of participants. This work was carried out within the framework of the scientific research topic of the Department of Public Health and Medical and Biological Foundations of Physical Culture, Sumy State Pedagogical University named after A. S. Makarenko.

## RESULTS

At the initial stage of the study in practice, the Carter-Wilkinson-Beighon method was used in the diagnosis of condition of the children’s articular apparatus. Evaluation of the hypermobility degree by this method included a scale for detecting the characteristics of JHM, and the number of points was ranked according to the degree of JHM. As a result, it was found out that the joints physiological mobility is inherent in  $14.45 \pm 2.16\%$  of the examined group, a slight degree of joints hypermobility –  $27.73 \pm 3.06\%$ , the average degree of joints hypermobility  $45.18 \pm 3.91\%$ , and expressed  $12.62 \pm 3.80\%$  of children.

According to the results of study, it was found that in children with joints hypermobility among the signs of morpho-functional involvement of the musculoskeletal system in orthopaedic appearances the largest proportion of lesions were functional changes in the spine structure on the example of mobility in the sagittal and frontal torso muscles planes. It was found out that with age, the spine hypermobility prevails among the children with moderate JHM ( $r = 0.32$ ;  $p < 0.001$ ). The spinal hypermobility predominates in children  $8.57 \pm 1.14\%$ .

A special attention should be paid to the indicators of lateral spine mobility to the right and left, as asymmetric mobility indicates a predisposition of children to hypertorsia and later – to scoliotic disease. As the result of the study, it was proved that in general, spine hypermobility on the right was determined in children  $1.79 \pm 0.54\%$ , and on the left – in children with JHM  $1.07 \pm 0.42\%$ . Moreover, among children with joints physiological mobility there was no excessive lateral spine mobility.

By analysing the functional indicators of static endurance of the muscles of the torso dorsal surface, it was found that  $74.75 \pm 1.56\%$  of children were dominated by below average and significant weakness of the back muscles, while the norm was only  $20.60 \pm 1.64\%$  of children. A similar tendency was observed among this group of children with HMJ in the endurance level of the muscles of the torso ventral surface: below average and significant weakness of the abdominal muscles prevailed in  $77.24 \pm 1.71\%$  of children.

At the second stage of studying the functional changes of the musculoskeletal system in children with articular appearances, a discriminant analysis and the prognosis of functional changes of musculoskeletal system (MSS) were performed among children with HMJ, the sensitivity and specificity of a priori classification were assessed. In addition,

there was the calculation of values matrices of the most reliable characteristics from the whole bulk of changes in the children’s morpho-functional state with JHM.

The classification consisted of comparing the discriminant function estimated for each indicator. The procedure of taking into account the indicators took place with a step-by-step involvement in the model of informativeness of the MSS indicators regarding the hierarchy of JHM levels.

Determination of significant indicators of the functional state of the MSS allowed to assess the degree of their difference (Table 1). It was stated that in children with JHM the most informative indicators are the spine mobility forward and endurance of the back muscles, and the spine mobility backwards and to the left were slightly lower. But given the calculated values, it should be noted that the progression of JHM in children to some extent was influenced by all indicators of the functional state of the MSS.

The next step was to construct a prognostic classification function according to the degree of HMJ (mild (y1), medium (y2), expressed (y3)), which allowed the value of the resulting function to predict the course of HMJ in children:

$$y_1 = -15.37 + 0.14 x_1 + 1.04 x_2 + 1.83 x_3 + 0.22 x_4 + 0.21 x_5 + 1.33 x_6$$

$$y_2 = -16.07 + 0.12 x_1 + 1.01 x_2 + 1.78 x_3 + 0.23 x_4 + 0.25 x_5 + 1.39 x_6$$

$$y_3 = -17.57 + 0.16 x_1 + 1.09 x_2 + 1.91 x_3 + 0.27 x_4 + 0.24 x_5 + 1.34 x_6$$

where y1 – mild JHM; y2 – medium degree of JHM; y3 – severe degree of JHM;  $x_1$  – forward mobility of the spine (cm);  $x_2$  – mobility of the spine back (cm);  $x_3$  – mobility of the spine to the right (cm);  $x_4$  – mobility of the spine to the left (cm);  $x_5$  – back muscles endurance (c);  $x_6$  – abdominal muscles endurance (number of repetitions).

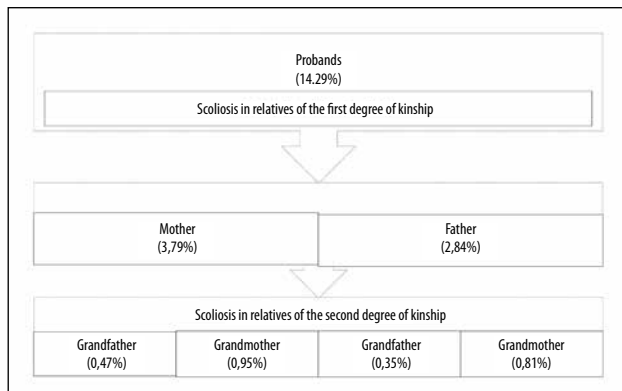
The ratio of the number of correctly classified factors to the total number of cases was calculated to assess the correctness and reliability of the priori classification. As a result, the specificity of the obtained classification turned out to be 78% reliable, which makes it possible to predict the peculiarities of JHM in children due to changes in morphofunctional characteristics of spinal mobility and strength of muscle corset.

Though appropriate prognosis models should be combined with alternative forecasting methods. Thus, in order to determine the probable predisposition of children with severe degree of JHM (probands) to the further progression of orthopaedic pathology, the genealogical anamnesis of relatives of the first (parents) and the second level of kinship (grandparents) was studied.

**Table 1.** Informativeness of functional indicators values of the musculoskeletal system concerning joints hypermobility in children (conventional units)

| Indicator                          | $\lambda$ | Partial $\lambda$ | Fisher Criterion (F) | p       |
|------------------------------------|-----------|-------------------|----------------------|---------|
| spine forward mobility             | 0.944     | 0.970             | 5.639                | <0.0001 |
| back muscles endurance             | 0.937     | 0.977             | 4.323                | <0.005  |
| abdominal muscles endurance        | 0.923     | 0.992             | 1.423                | 0.05    |
| mobility of the spine to the right | 0.917     | 0.999             | 0.169                | 0.01    |
| mobility of the spine to the left  | 0.917     | 0.998             | 0.189                | 0.01    |
| spine back mobility                | 0.919     | 0.9965            | 0.553                | 0.01    |

Note:  $\lambda$  (Wilkes lambda) is the ratio of the determinant of the matrix of intragroup variances to the determinant of the total covariance function. The value of  $\lambda$  belongs to the interval 0.1.



**Figure 1.** Distribution of children relatives with severe degree of joints hypermobility, who have scoliosis, %

The following pattern among relatives of the first degree of affinity of scoliosis was observed more in women than in men (3.79% and 2.84%, respectively), which confirms the predisposition of females to connective tissue disorders (Figure 1).

During the genealogical analysis of the clinical manifestation of orthopaedic pathology in families, it was found that the risk of possible scoliosis in children with severe HMJ increases to 2.41 cases (with a confidence interval of 0.93-0.94), the predisposition to flat feet in children with HMJ is determined in 2.73 cases (at a confidence interval of 1.02-7.73), to dental-maxillary anomalies – in 1.64 cases (at a confidence interval of 1.17- 2.03).

## DISCUSSION

The state of the children articular apparatus was diagnosed and divided by a hierarchy of degrees on the physiological joints mobility into: mild, moderate and severe at the initial stage of study by the method of Carter-Wilkinson-Beighon. The next step was to determine the proportion of major signs of morpho-functional involvement of the musculoskeletal system on the background of joint hypermobility in 4-6-year-old children (functional changes in the spine structure on the example of mobility in the sagittal and frontal planes, as well as endurance of dorsal and ventral groups of torso muscle).

The determinants study for predicting local involvement of musculoskeletal structures against the background of joints hypermobility in children began with discriminant analysis, the sensitivity and specificity of a priori classification were later assessed and the informativeness of the musculoskeletal system was included step by step into the model.

The significance of high informativeness of the spinal mobility indicators in the sagittal and muscles endurance of the torso dorsal surface in relation to the probable involvement of the pathological process was established and the prognostic classification function was determined.

Another prognosis component of the clinical flow of orthopaedic changes and the interpretation of the main clinical appearances was the genealogical anamnesis of several

generations, the main condition of which was a survey of family members, which allows identifying symptoms of connective tissue lesions by gender differences: females had more appearances.

## CONCLUSIONS

Thus, the risk of probable progression of orthopaedic pathology in children with severe hypermobility degree is quite significant – scoliotic disease in 2.41 cases, flat foot – in 2.73 cases.

We can see the prospects for further research in proving the effectiveness and practical significance of the developed program of complex prevention of the orthopaedic pathology progression in children against the background of severe joints hypermobility.

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**ADDRESS FOR CORRESPONDENCE:****Tetiana Buhaienko**

Department of Health, Physical Therapy, Rehabilitation and Ergotherapy,  
Sumy State Pedagogical University, Sumy, Ukraine  
e-mail: tetiana.buhaienko@ukr.net

**ORCID ID and AUTHORS CONTRIBUTION**

0000-0002-9093-2180 – Yuliia Tonkoei (A, C, D, E)  
0000-0003-4214-4515 – Olha Skyba (B, C, D)  
0000-0001-7784-5691 – Viktor Bondarenko (A, D, E)  
0000-0003-3745-0593 – Tetiana Buhaienko (A, D, F)  
0000-0002-5468-7974 – Yurii Kurnyshev (B, C, D, E, F)  
0000-0002-2147-2280 – Tetiana Liasota (C, E, F)

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



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# Comparative Analysis of Complex Programs of Renewal Treatment of Patients with Chronic Pancreatitis

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Liliya S. Babinets, Zoriana I. Sabat, Olha O. Salamadze, Zoreslava Ya. Onufryk

Horbachevsky Ternopil National Medical University, Ternopil, Ukraine

## SUMMARY

**Aim:** To conduct a comparative analysis of the dynamics of heart rate variability parameters in CP patients with autonomic dysfunction under the influence of the proposed complex treatment programs with the additional inclusion of the vegetative stabilizing agent memoplant and a combination of complex bioregulatory drugs.

**Materials and Methods:** Statistical and spectral parameters of heart rate variability were analyzed in 69 patients with CP before and after outpatient treatment. Patients were divided into 3 groups of 23 patients with CP: group 1 – received conventional treatment (CT) according to the clinical diagnosis and the protocol proposed by the Ministry of Health of Ukraine (Order No. 638 of 10.09.2014); group 2 – CT enhanced with a course of the vegetative-stabilizing drug ginkgo biloba (memoplant); 3 group – CT with a course of memoplant and complex bioregulatory therapy (BRT): *momordica compositum*, *traumeel S* and *neurexan* according to the proposed scheme.

**Results:** In group 1, the stress index (SI) decreased by 18.49%,  $p < 0.05$ , vegetative reactivity (VR) increased by 21.31%,  $p < 0.05$ , IARS decreased by 25.79%,  $p < 0.01$ . In group 2, a more significant decrease in sympathicotonia was observed: SI decreased by 38.17% ( $p < 0.01$ ), mode amplitude ( $A_{mo}$ ) by 14.57% ( $p < 0.05$ ), the range of variation (X) increased by 12.78% ( $p < 0.05$ ); IARS decreased by 44.55% ( $p < 0.01$ ) to moderate tension. There was an increase in the total spectrum power (TP) (by 29.21%,  $p < 0.01$ ) and components: LF increased by 37.03% ( $p < 0.01$ ) relative to the initial level, HF by 64.01% ( $p < 0.01$ ), VLF by 8.75% ( $p < 0.05$ ). In patients of group 3, normalization of SI and  $A_{mo}$  was observed (indicators decreased by 48.42% and 19.98%,  $p < 0.01$ ), X increased by 17.35%,  $p < 0.01$ ; The VR level did not differ significantly from the control ( $1.16 \pm 0.06$  and  $1.25 \pm 0.10$ , respectively). IARS decreased by 56.18% ( $p < 0.01$ ); TP increased by 49.61% ( $p < 0.01$ ), LF by 76.78% ( $p < 0.01$ ), HF by 117.67% ( $p < 0.01$ ), VLF by 8.41% ( $p < 0.05$ ).

**Conclusions:** In patients with CP, a higher efficiency of treatment programs with the inclusion of ginkgo biloba and complex bioregulatory therapy on the state of autonomic regulation was established compared to the generally accepted program in terms of spectral and statistical parameters of heart rate variability.

**Key words:** chronic pancreatitis, autonomic nervous system, heart rate variability, bioregulatory therapy.

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## INTRODUCTION

Autonomic dysfunction (AD) plays an important role in the pathogenesis of diseases of the gastrointestinal tract, including chronic pancreatitis (CP) [1, 2]. The peculiarities of AD in diseases of the gastrointestinal tract are that changes occur mainly at the level of the central link of vegetative regulation and are polysystemic in nature, which leads to the impairment of adaptation mechanisms within the whole organism, including vegetative regulation of the digestive system. Therefore, the conclusion about the functional state of autonomic nervous system (ANS) in pancreatitis can be made on the basis of an assessment of the autonomic regulation of the cardiovascular system, for example, by assessing heart rate variability [2-6].

Stress of any origin, anxiety disorders lead to autonomic dysregulation, the development of a psychovegetative syndrome and, as a result, to homeostasis disorders [4, 7, 8].

The use of methods that can limit the excessive stress response, as well as normalize the insufficient protective reaction, is relevant. Among these methods, bioregulatory therapy is promising in terms of prevention and correction of stress injuries [9-12]. One of the main tasks of the treatment process is to improve the patient's quality of life [7, 13]. Complex bioregulatory drugs and naturopathic standardized herbal remedies, in particular ginkgo biloba preparations [14-17], cause allergic reactions much less frequently than synthetic drugs, act gently and gradually, can be used for a long time, which increases treatment adherence and makes them an important component of the correction of autonomic and psycho-emotional disorders in people with CP.

## AIM

The aim was to conduct a comparative analysis of the dynamics of heart rate variability parameters in CP patients

with autonomic dysfunction under the influence of the proposed complex treatment programs with the additional inclusion of the vegetative stabilizing agent memoplant and a combination of complex bioregulatory drugs.

## MATERIALS AND METHODS

Statistical and spectral parameters of heart rate variability (HRV) were analyzed in 69 patients with CP before and after outpatient treatment. The following indicators of HRV were analyzed: the range of variation (X), mode amplitude ( $A_{Mo}$ ), stress index (SI), vegetative reactivity (VR), indicator of activity of regulatory systems (IARS), total spectrum power (TP), very low frequency power (VLF), low frequency power (LF), high frequency power (HF). Group 1 – received conventional treatment (CT) according to the clinical diagnosis and the protocol proposed by the Ministry of Health of Ukraine (Order No. 638 of 10.09.2014); group 2 – CT enhanced with a course of the vegetative-stabilizing drug ginkgo biloba (memoplant), used 1 tablet 3 times a day with meals, washed down with half a glass of water, a course of 1 month; 3 group – CT with a course of memoplant and complex bioregulatory therapy (BRT): momordica compositum (1 ampoule 2.2 ml intramuscularly 2 times a week №10), traumeel S (1 ampoule 2.2 ml intramuscularly every other day No. 10) and neurexan (1 tab 3 times a day, course 1 month) according to the proposed scheme. The comparison groups were comparable in terms of gender, age and social characteristics. The proportion of men among the examined was 48 % (n = 33), women – 52 % (n = 36). The average duration of the disease was (9.1 ± 3.8) years. Exclusion criteria from the study were acute diseases, exacerbation of chronic diseases, hematological, oncological, mental diseases, refusal to participate in the study. The control group consisted of 20 practically healthy individuals of comparable age and gender.

The average values as well as their standard errors were calculated and analyzed. The probability of discrepancies in the average values (p) was assessed using Student's t-test for indicators with normal data distribution. Non-parametric tests were used for totality whose distribution differed from normal: Mann-Whitney U-test – to compare two independent samples, Wilcoxon W-test – to assess dynamic changes within groups. The results were considered reliable at the level of their statistical significance  $p < 0.05$ .

## RESULTS

By analyzing the HRV of individuals with CP before treatment, a tendency to sympathicotonia was found among them, which was accompanied by a significant increase relative to the control group in mode amplitude, SI and a decrease in the range of variation. In patients with CP, there was also a significant decrease in the of the TP compared to the control group, which is a sign of a decrease in the functional reserve among them. In contrast to the group of healthy individuals, in patients with CP, the humoral-metabolic effect of heart rate regulation prevailed, however, the absolute values of VLF were not

significantly different from the control indicators and also the share of the nervous component decreased. Against a backdrop of the depletion of functional reserves in patients with CP, a decrease in the adaptive potential in terms of IARS was also observed, the value of which corresponded to the upper limit of the expressed tension of the regulatory systems and significantly differed from that in the control group. Unlike the control group, in which vegetative reactivity was normal ( $1.25 \pm 0.10$ ) during the orthostatic test, asympathicotonic VR was observed among patients with CP. The decrease in the ability of the ANS to respond adequately to the load is probably caused by more significant efforts to maintain the background regime, which also confirms the depletion of regulatory mechanisms in patients with CP.

Table 1 shows a comparison of dynamics of HRV parameters in patients with CP under the influence of various treatment methods. According to the dynamics of HRV parameters, it was found that sympathicotonia slightly decreased due to CT: SI decreased by 18.49% ( $p < 0.05$ ) compared to the initial values,  $A_{Mo}$  by 3.51%, X increased by 3.66%. The body's response to orthostasis improved, changing from asympathicotonic to the lower level of normal for initial sympathicotonia ( $0.74 \pm 0.07$ ). IARS decreased by 25.79%,  $p < 0.01$ , from the expressed tension of the regulatory systems to moderate ( $6.63 \pm 0.26$  versus  $4.92 \pm 0.32$  respectively). Functional reserves increased slightly and did not significantly differ from those before treatment, which indicates a lack of effectiveness of CT on concomitant dysfunction of the ANS, in particular, TP increased by 5.77%, LF by 7.16%, HF by 6.78%, VLF by 2.77%.

Inclusion of memoplant to the CVT in the 2nd study group contributed to the improvement of autonomic regulation due to a more significant decrease in sympathicotonia: SI decreased by 38.17%,  $p < 0.01$  relative to the initial values,  $A_{Mo}$  by 14.57%,  $p < 0.05$ , X increased by 12.78%,  $p < 0.05$ . The increase in VR was more significant compared to group 1, but still significantly differed from the control values. IARS decreased by 44.55%,  $p < 0.01$  to moderate tension. We also observed a more significant increase in both TP (by 29.21%,  $p < 0.01$ ) and components, especially

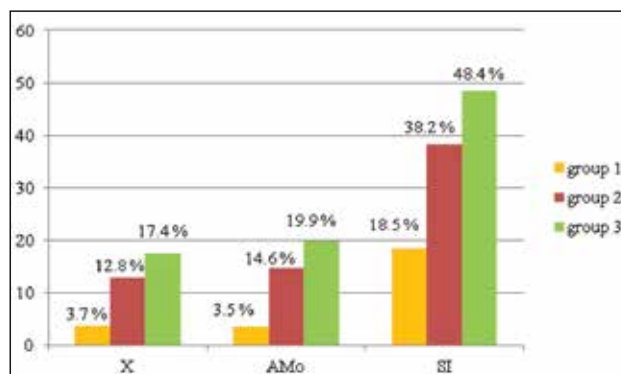


Figure 1. Percentage dynamics of HRV spectral parameters in patients with CP in relation to those before treatment in the comparison groups

**Table 1.** Dynamics of HRV parameters in patients with CP under the influence of various treatment methods

| Indicator            | Control group<br>(n=20) | Stage | Examined group                               |   |   |
|----------------------|-------------------------|-------|--|---|---|
|                      |                         |       | CVT<br>(n=23)                                | CVT + memoplant<br>(n=23)                       | CVT + memoplant + BRT<br>(n=23)                 |
|                      |                         |       | 1  | 2   | 3   |
| X, ms                | 273.10±15.71            | I     | 256.30±26.60                                 | 249.54±20.89                                    | 253.75±25.52                                    |
|                      |                         | II    | 265.69±11.87<br>(p <sub>1-2</sub> <0.05)     | 281.44±8.13#<br>(p <sub>2-3</sub> <0.05)        | 297.78±6.07##<br>(p <sub>1-3</sub> <0.01)       |
| A <sub>Mo</sub> , %  | 36.05±2.47              | I     | 51.82±3.67**                                 | 52.22±3.44**                                    | 49.08±2.98**                                    |
|                      |                         | II    | 50.0±3.24**<br>(p <sub>1-2</sub> <0.05)      | 44.61±2.11**#<br>(p <sub>2-3</sub> <0.01)       | 39.27±1.28##<br>(p <sub>1-3</sub> <0.01)        |
| SI                   | 69.60±7.79              | I     | 126.41±14.93**                               | 130.37±13.56**                                  | 128.63±11.80**                                  |
|                      |                         | II    | 103.04±7.32**#<br>(p <sub>1-2</sub> <0.01)   | 80.61±7.01##<br>(p <sub>2-3</sub> <0.05)        | 66.35±4.11##<br>(p <sub>1-3</sub> <0.01)        |
| IARS, points         | 3.9±0.31                | I     | 6.63±0.26**                                  | 6.98±0.22**                                     | 7.12±0.27**                                     |
|                      |                         | II    | 4.92±0.32**##<br>(p <sub>1-2</sub> <0.01)    | 3.87±0.25##<br>(p <sub>2-3</sub> <0.05)         | 3.12±0.28*##<br>(p <sub>1-3</sub> <0.01)        |
| VR                   | 1.25±0.10               | I     | 0.61±0.07**                                  | 0.58±0.10**                                     | 0.65±0.09**                                     |
|                      |                         | II    | 0.74±0.05**#<br>(p <sub>1-2</sub> <0.01)     | 1.03±0.08*##                                    | 1.16±0.05##<br>(p <sub>1-3</sub> <0.01)         |
| TP, ms <sup>2</sup>  | 3155.65±211.38          | I     | 1560.28±95.33**                              | 1541.80±89.92**                                 | 1549.75±92.65**                                 |
|                      |                         | II    | 1650.34±99.33<br>** (p <sub>1-2</sub> <0.01) | 1992.20±104.41<br>***# (p <sub>2-3</sub> <0.01) | 2318.60±100.80**<br>## (p <sub>1-3</sub> <0.01) |
| VLF, ms <sup>2</sup> | 783.4±90.95             | I     | 735.11±29.70                                 | 708.76±30.10                                    | 722.55±28.42                                    |
|                      |                         | II    | 755.50±28.55                                 | 770.80±30.44#                                   | 783.31±27.85#                                   |
| LF, ms <sup>2</sup>  | 1278.1±74.98            | I     | 495.30±41.65**                               | 520.16±45.40**                                  | 501.58±40.39**                                  |
|                      |                         | II    | 530.76±65.65**<br>(p <sub>1-2</sub> <0.01)   | 712.80±60.28**<br>## (p <sub>2-3</sub> <0.01)   | 886.70±58.80**##<br>(p <sub>1-3</sub> <0.01)    |
| HF, ms <sup>2</sup>  | 1094.15±102.49          | I     | 328.62±22.40**                               | 320.55±28.59**                                  | 311.85±25.15**                                  |
|                      |                         | II    | 349.91±24.38**<br>(p <sub>1-2</sub> <0.01)   | 525.74±22.25**<br>## (p <sub>2-3</sub> <0.01)   | 678.80±23.60**##<br>(p <sub>1-3</sub> <0.01)    |

**Notes:**

I – indicator before the start of treatment; II – indicator after completion of treatment;

\* – a significant difference in the indicator in relation to such a control group, p&lt;0.05, \*\* – p&lt;0.01;

# – significant difference in indicators compared to those before treatment, p&lt;0.05, ## – p&lt;0.01.

the nervous component: LF increased by 37.03 %, HF by 64.01%, p<0.01, while VLF by 8.75%, p<0.05. Figure 1 shows a percentage dynamics of HRV spectral parameters in patients with CP in relation to those before treatment in the comparison groups.

Strengthening of the vegetative stabilizing effect of memoplant by the course of BRT in patients of the 3rd group was manifested by the normalization of SI and A<sub>Mo</sub> (indicators decreased by 48.42% and 19.98 %, p<0.01). X at the end of treatment increased by 17.35%, p<0.01 its value exceeded the norm, which is probably due to compensatory strengthening of the parasympathetic division of the ANS. In the last group, it was possible to achieve a VR level that did not significantly differ from the control (1.16±0.06 and 1.25±0.10 respectively). This indicates an increase in the reserve forces of the ANS, which ensures a normal reaction of the body to the stress.

IARS decreased by 56.18%, p<0.01 relative to the control to the lower limit of moderate tension. The dynamics of the spectral parameters, which were traced when memoplant was included in the CVT, increased even more in the third group: TP increased by 49.61%, LF by 76.78%, HF by 117.67%, p<0.01, VLF by 8.41%, p<0.05.

**DISCUSSION**

All organs and systems of our body are under the constant control of the ANS. Autonomic disorders play an important role in the development and course of almost all pathological conditions. In some cases, they are a significant factor in pathogenesis, in others they occur secondarily, in response to damage to various body systems [1, 3, 8]. To sum up the results of our research, we can argue that patients with CP are characterized by dysfunction of the ANS. Therefore, it's advisable to prescribe vegetostabilizing drugs.

According to the literature data, ginkgo biloba preparations have a vegetative-stabilizing effect, improve the quality of life, and reduce the manifestations of asthenia [7, 13-17]. Selected bioregulatory drugs (momordica compositum, traumeel S and neurexan) can not only reduce clinical symptoms, but also normalize vegetative status, regulate hormonal and metabolic status [9-12].

In our study, we found a more pronounced positive effect of complex therapy with the addition of memoplant and bioregulatory therapy on the statistical and spectral parameters of HRV. The inclusion of memoplant in the CT contributed to a more significant decrease in sympathicotonia, improved body response to orthostasis, reduced IARS to a moderate level, and a significant increase in the body's functional reserves. Add of BRT increased the described dynamics ( $p < 0.01$ ).

Therefore, the use of memoplant and BRT in addition to protocol treatment schemes more effectively affects the state of autonomic regulation of patients with CP.

## CONCLUSIONS

1. It was established that patients with CP are characterized by dysfunction of the ANS, manifested by a tendency among them to sympathicotonia according to a significant increase in  $A_{Mo}$ , SI and a decrease in X relative to the parameters of the control group. Against a backdrop of the depletion of functional reserves in patients with CP, according to a significant decrease in TP, a decrease in adaptive potential was observed according to IARS. The depletion of the functional reserves of the organism of patients with CP was also indicated by an asympathicotonic reaction to an orthostatic test.
2. The inclusion of the vegetative-stabilizing drug memoplant in the CVT contributed to a more significant decrease in sympathicotonia: SI decreased by 18.49%,  $p < 0.05$  in group 1 and by 38.17%,  $p < 0.01$  in group 2, in group 2 it also significantly decreased  $A_{Mo}$  – by 14.57 %, X increased by 12.78%,  $p < 0.05$ ; the body's response to orthostasis improved, IARS decreased to a moderate level (by 25.79 % in group 1 and by 44.55% in group 2,  $p < 0.01$ ). Additional addition of BRT in the 3rd group increased the named dynamics:  $A_{Mo}$  and SI were normalized (decreased by 48.42% and 19.98% respectively,  $p < 0.01$ ), X increased compensatory (by 17.35%,  $p < 0.01$ ), the ANS reserve forces increased according to the reaction to the orthostatic test and the adaptive capacity according to IARS improved (decreased by 56.18 %,  $p < 0.01$ ).
3. Functional reserves in terms of spectral indicators increased significantly only in groups 2 and 3. The addition of memoplant and BRT to the CT contributed to

the growth of TP (by 29.21% in group 2 and by 49.61 % in group 3,  $p < 0.01$ ), and components, especially the nervous component (LF increased by 37.03 %, HF by 64.01%,  $p < 0.01$ , VLF by 8.75%,  $p < 0.05$  in group 2 and by 76.78%, 117.67%,  $p < 0.01$ , 8.41%,  $p < 0.05$  respectively in group 3).

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**Conflict of interest:**

The Authors declare no conflict of interest

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**ADDRESS FOR CORRESPONDENCE:**

**Liliya S. Babinets**

Horbachevsky Ternopil National Medical University

14 Kupchyns'ky St., 46000 Ternopil, Ukraine

phone: +380673520743

e-mail: lilyababinets@gmail.com

**ORCID ID and AUTHORS CONTRIBUTION**

0000-0002-0560-1943 – Liliya S. Babinets (A, B, C, D, E, F)

0000-0003-4744-8040 – Zoriana I. Sabat (A, B, C, D)

0000-0001-5896-5452 – Olha O. Salamadze (C, D)

0000-0002-0054-5495 – Zoreslava Ya. Onufry (B, C, D)

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



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# Cardiovascular Reaction to Orthostatic Test Among Non-functional Overreaching Athletes with Vegetative Disorders (The Physical Therapist Perspective)

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Valentina Shevets<sup>1</sup>, Liudmila Sherstiuk<sup>2</sup>, Valentyna Bumeister<sup>1</sup>, Volodymyr Lychko<sup>1</sup>, Oleksii Korenkov<sup>1</sup>, Tetiana Ivakhnyuk<sup>1</sup>, Dmytro Sotnikov<sup>1</sup>, Iryna Brizhata<sup>1</sup>

<sup>1</sup>Sumy State University, Sumy, Ukraine

<sup>2</sup>Karazin Kharkiv National University, Kharkiv, Ukraine

## SUMMARY

**Aim:** The non-functional overreaching requires a deeper study because its diagnosing is not based on conventional methods. Orthostatic and clinostatic tests make it easy and quick to detect health problems. The purpose of this research is defining orthostatic reactions among 68 athletes with and without signs of non-functional overreaching.

**Materials and Methods:** Our research comprises 2 groups of 68 athletes subdivided by presence of non-functional overreaching. The first group includes 27 persons with vegetative disorder signs. The second group covers 41 individuals without non-functional overreaching. For all of them, we conducted orthostatic tests to record blood pressure and heart rate horizontally and vertically.

**Results:** The research showed that 9 athletes (33.3% of the O+ group) had unsatisfactory results after body tests in horizontal and vertical positions. All athletes revealed the orthostatic tolerance disorder. For 5 sportsmen, the latter was accompanied by the clinostatic overreaction. Resting heart rate did not vary considerably between both groups ( $p=0.412$ ). However, orthostatic tests reflected the sharp index rise among 9 individuals. For non-functional overreaching athletes, the mean value ( $p<0.001$ ) exceeded the corresponding one in the O- group more than twofold.

**Conclusions:** Although today it is possible to differentiate orthostatic-clinostatic tolerance from vegetative dysfunction, further research must be conducted to clarify this syndrome types and to improve physical recovery for non-functional overreaching athletes.

**Key words:** vegetative dysfunction, orthostatic test, athletes, non-functional overreaching, heart rate variability, recovery

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## INTRODUCTION

Also known as the non-functional overreaching, the athletic insufficient productivity is characterized by tiredness and inability to exercise in contrast to initial performance. While food, hormone imbalance and vegetative anomalies were offered as features of this symptom, no consistent non-functional overreaching biomarker was detected. Available recovery methods are foremost aimed at stress decrease, nourishment optimization and adequate rest [1, 2].

One of possible vegetative problems among non-functional overreaching athletes is the orthostatic tolerance disorder. In particular, many scientists (Rodrigues GD et al.) studied the orthostatic tolerance prevalence for non-functional overreaching athletes [3]. Fisher CJ et al. researched the tolerance within a group of 39 non-functional overreaching females in comparison to a control group of 35 humans. Postural tachycardia prevailed in the experimental group (41%) against the control one (11%). The postural hypotension prevalence was lower (~26%); the groups did not differ in

this index significantly. The orthostatic-clinostatic tolerance symptoms were heavier and more frequent in the experimental group [4].

For athletes and coaches, the health state and productivity checks are critical to detect the non-functional overreaching in advance [5]. To control physical load, the heart rate (HR) and heart rate variability (HRV) are often measured to individualize exercises and find non-functional overreaching on the early stage. The vagal heart check reflects the vagus activity. The latter regulates the heart functioning. It can be defined via the HRV.

Usually, the HRV analysis is based on the resting data of lying or sitting positions. However, resting values are considered by someone as insufficient for non-functional overreaching detection [6, 7]. The passive backward head tilt in horizontal or vertical positions causes specific alternation in spectral HRV features. The reason for that is lower vagal and higher sympathetic outflow. Such a test shows that the body position change can provide additional data on principles

of vegetative heart regulation [8]. The active switch from horizontal to vertical states brings the human organism to stress because of the gravitational blood afflux in splanchnic or leg veins. Therefore, the vegetative nervous system must keep hemodynamics to prevent cerebral hypoperfusion. Within the horizontal-to-vertical switch, the HR rises. Besides, the high-frequency parasympathetic intensity decreases while the low-frequency partially sympathetic one increases [1, 9].

The body position alternations can provoke peculiar reactions of the HR dynamics. Consequently, they give a more detailed information on principles of the vegetative nervous regulation among non-functional overreaching athletes. In case of the orthostatic tolerance assessment for the lying and standing HRV, various cardiopulmonary receptors are engaged. In such a manner, the heart is overloaded, which changes the plasma volume and/or the peripheral vasomotor tone [10]. Along with other factors, these parameters may keep changes of vegetative models and HRV during different exercises. To obtain more accurate monitoring results, the cardiac vegetative function should be evaluated in two positions – horizontal and vertical – rather than only one.

### AIM

The research is aimed at defining orthostatic reactions among athletes with and without signs of non-functional overreaching.

### MATERIALS AND METHODS

Totally, we examined 68 athletes subdivided into 2 groups by presence of non-functional overreaching. The first group comprised 27 dysautonomia persons with overtraining (O+). The average age was 22.5 (3.2) years. There were 11 females (40.7%). The second group included 41 individuals without overtraining (O-). The average age was 22.3 (2.30) years. There were 20 females (48.8%). Both samples matched the age distribution criterion; their members did not differ significantly in age, sex as well as training duration and intensity ( $p>0.05$ ).

To estimate the resting blood pressure (BP), we applied the auscultatory method with appropriate cuff size (according to the office standard of BP measurement) [3]. In each one minute, we defined BP and HR three times on right and left limbs. Then, we calculated the mean BP value between the last two measurements. If BP on separate limbs differed, the higher measurement values were taken into account. All athletes passed a conventional active orthostatic test [11]. The test comprised the following steps: the clinostatic position for 3-5 minutes till the HR stabilization; the BP and

HR horizontal measurement; standing up; the BP and HR vertical measurement at the beginning and end of the first minute; the same measurement at the end of the second, third and fourth minutes. Within the test, we regarded some features as signs for vegetative regulation disorder. They included the systolic blood pressure (SBP) rise by over 20 mm Hg; the diastolic blood pressure (DBP) rise only; the standing-up HR growth by over 30 bpm and the same by over 40 bpm (in case of standing for above one minute); dizziness; blackout; head congestion; weakness; the transient SBP fall by above 15 mm Hg after standing up (it is especially bad if coincides with the DBP rise); the SBP decrease by above 20 mm Hg since the first standing minute; no hemodynamic recovery in 3 test minutes ( $\Delta$ SBP, DBP<5 mm Hg,  $\Delta$ HR<6 bpm).

The statistical analysis was conducted via the *socscistatistics* web service. We used the conventional statistical methods to calculate M (mean) and SD (standard deviation). These data were compared among groups by the Mann-Whitney rule. Categorical variables were expressed as percentages and analyzed using the chi-squared test ( $\chi^2$ ) as appropriate. Statistical significance was defined as two-sided  $P < 0.05$ .

### RESULTS AND DISCUSSION

Objective parameters of organism functioning play an important role. They make it easier to detect autonomic regulation disorders (even if there are no complaints). We examined the visiting athletes at the Sports Medicine Center. Subsequently, main hemodynamic parameters were defined via office measurement. Some of them are shown in Table 1.

Among athletes with autonomic regulation disorders, the absolute BP values prevailed considerably (that concerns SBP, DBP, MBP, PBP). Even office measurements for 12 O+ persons established the high normal SBP while only 4 O- representatives showed the same ( $p=0.001$ ). Usually, systolic prehypertension for O+ people with the high normal SBP confronted diastolic prehypertension (83.3%). Within the O-group, that was registered only in 1 respective case (25%). This can indicate a certain value of office prehypertension among overtraining athletes with vegetative dysfunction. The PBP and MBP dominance for the O+ group reflects a great SBP value, which can be caused by prevalence of corresponding cardiogenic regulatory influence. At the same time, HR did not differ in both groups significantly ( $p=0.412$ ). However, the O+ group HR tended to increase.

During the horizontal-to-vertical switches, unsatisfactory test results were found among 9 persons (33.3% of O+ group participants). All athletes had orthostatic tolerance disorders.

**Table 1.** Main hemodynamic indexes before orthostatic and clinostatic tests (initial measurements)

| Index    | O+            | O-            | P       |
|----------|---------------|---------------|---------|
| HR (AS)  | 61.26 (9.63)  | 59.24 (9.55)  | 0.412   |
| SBP (AU) | 126.41 (6.98) | 122.24 (4.93) | < 0.001 |
| DBP (AW) | 83.07 (3.39)  | 74.1 (6.13)   | < 0.001 |
| PBP (AY) | 43.33 (5.55)  | 48.39 (6.98)  | < 0.001 |
| MBP (BA) | 97.52 (4.02)  | 90.07 (4.71)  | < 0.001 |

HR – heart rate; SBP – systolic blood pressure; DBP – diastolic blood pressure; PBP – pulse blood pressure; MBP – mean blood pressure

5 individuals of this group additionally possessed the excessive clinostatic reaction. The initial O+ group SBP prevailed over the O- group one (126.41 mm Hg against 122.24 mm Hg;  $p < 0.001$ ). As it is indicated on figures 1 and 2, the mean cardiovascular reaction was more obvious for the O+ members. It significantly exceeded the same among the O- participants ( $p < 0.001$  for the whole examination period).

Within the O+ sample orthostatic test, the more considerable SBP fall coincided with the higher standard deviation (up to 6.8) during the third minute. Moreover, the different SBP decrease speed in both groups caused variability of respective diagram curves. The greatest difference was established between the first and third minutes. During the third minute, the O- group SBP returned to previous values (the contrast to initial values is under 2 mm Hg). Simultaneously, the O+ group SBP mean did not recover and exceeded by 8 mm Hg (Figure 1).

Within this group, the quick SBP normalization occurred between the third and fifth minutes against the first and third minutes of the opposite group. After 5 test minutes, there was no SBP recovery to initial values among 4 non-functional overreaching athletes (the difference was above 5 mm Hg). For all O- participants, SBP did not exceed that value during the fifth minute. It signifies a worse cardiovascular reaction of O+ people to orthostatic stimuli. Also, it implies lower organism's adaptability.

The DBP orthostatic reaction is shown on Table 2. Within two groups, no significant mean aberrations were detected. However, non-functional overreaching athletes demonstrated higher mean aberrations. Since the second minute, their DBP tended to rise while the O- group DBP recovered gradually. For both groups, we registered no considerable disorder of the DBP recovery.

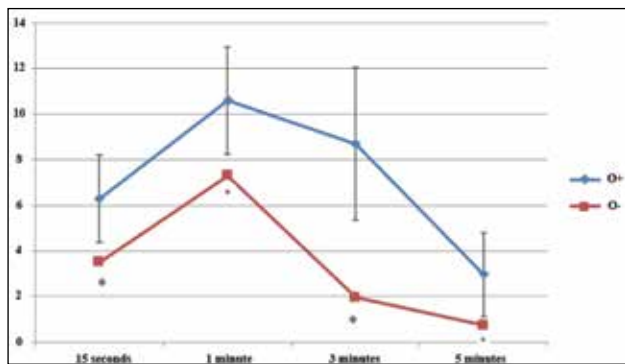
In the orthostatic test dynamics, the BP comparison indicates the PBP fall among the O+ individuals (since the third minute) versus no such changes in the O- group. This fact is undesirable for athletes: it reflects the adaptive reserve decrease. We think so because it is generally known the PBP growth shows the physiological reaction to intensive exercise.

For both groups, the resting heart rate did not differ significantly ( $p = 0.412$ ). Along with that, the orthostatic test (Figure 2) established the excessive rise of the resting heart rate among 9 persons. During the entire measurement, the O+ group mean prevailed over the O- group value by more than two times ( $p < 0.001$ ). The O- standard deviation was proportionally lower against the opposite group. In terms of the blood circulation, the O+ and O- group HR recovered in the same way (in contrast to SBP, the highest speed was observed between the first and third minutes). At the test end, the HR means normalized. However, those of the O+ sample significantly exceeded the O- values ( $p < 0.001$ ). For 7 people, HR exceeded the initial values by above 6 bpm. The top excess point was 15 bpm. In such a case, athletes felt slightly dizzy and weak.

Thus, for non-functional overreaching athletes, the unsatisfactory hyperergic HR reaction to the clinostatic-orthostatic test demonstrates the considerable adaptive shifts of vegetative basal tones and higher sympathetic influence.

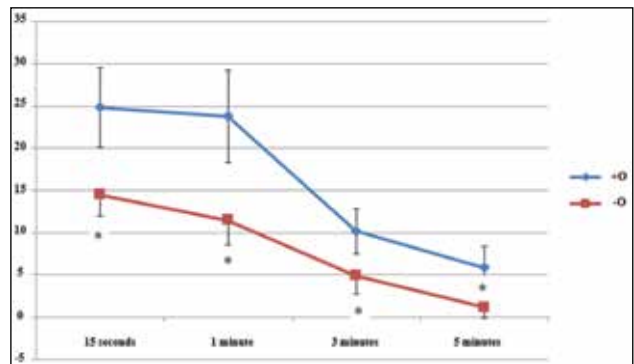
**CONCLUSIONS**

Non-functional overreaching athletes possess a worse cardiovascular reaction to orthostatic stimuli: a more obvious SBP fall, a higher HR and their longer recovery. The orthostatic traumatism risk and subsequent pathologies require further research.



Note: \* stands for  $p < 0.05$

Figure 1. The SBP decrease dynamics during the orthostatic test



Note: \* stands for  $p < 0.001$

Figure 2. The HR increase dynamics during the orthostatic test

Table 2. The DBP decrease during the orthostatic test (mm Hg)

|    | Initial DBP  | 15 seconds  | 1 minute    | 3 minutes    | 5 minutes    | P   |
|----|--------------|-------------|-------------|--------------|--------------|---|
| O+ | 83.07 (3.39) | 1.67 (7.84) | 0 (7.34)    | -0.19 (5.63) | -1.67 (3.39) | $P_1 < 0.001$<br>$P_2 = 0.194$                  |
| O- | 74.1 (6.13)  | 3.41 (3.43) | 5.24 (4.46) | 0.98 (2.0)   | 0.37 (1.32)  | $P_3 = 0.002$<br>$P_4 = 0.190$<br>$P_5 = 0.032$ |



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### ADDRESS FOR CORRESPONDENCE:

#### Valentina Shevets

Department of Physical Therapy, Occupational Therapy and Sports Medicine, Sumy State University, 40000, Sumy, Ukraine  
e-mail: v.buivalo@med.sumdu.edu.ua

### ORCID ID and AUTHORS CONTRIBUTION

0000-0003-0684-5314 – Valentina Shevets (A, B, D)

0000-0002-2993-2843 – Liudmila Sherstiuk (E)

0000-0001-8604-4458 – Valentyna Bumeister (F)

0000-0001-5518-5274 – Volodymyr Lychko (A):

0000-0002-1314-5642 – Oleksii Korenkov (D)

0000-0001-5851-2218 – Tetiana Ivakhnyuk (C)

0000-0001-8030-0369 – Dmytro Sotnikov (E)

0000-0002-9988-4285 – Iryna Brizhata (F)

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



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# Informal Professional Communication of Rehabilitation Specialists and its Significance for their Practical Activities

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**Valeriya Brych, Mariana M. Dub**

Uzhhorod National University, Uzhhorod, Ukraine

## SUMMARY

**Aim:** To investigate the scope, forms and activeness of informal professional communication of rehabilitation specialists using information and communication channels and its significance for their practical activities.

**Materials and Methods:** The following methods were used during the research: sociological; statistical; structural and logical analysis; generalization. Copies of the author's original sociological survey questionnaire were used as research materials.

**Results:** The analysis of the results of survey revealed that absolutely all interviewed rehabilitation specialists consider it useful to create virtual groups for professional communication with colleagues in the field of rehabilitation through modern information and communication channels. 44.9±3.7% of respondents recognized themselves as passive participants of such groups. But 98.9±0.8% of the survey participants consider the information received in such communication groups to be useful for professional clinical activities in the field of rehabilitation. It was determined that the issues of correct preparation of documentation when providing services under the packages of the National Health Service of Ukraine (78.7±3.1%) and the problems of organizing the provision of rehabilitation services in health care facilities (74.2±3,3) were discussed most often in the groups.

**Conclusions:** The development of virtual professional communities of rehabilitation specialists helps them to exchange information and improve their knowledge in matters of organizing the provision of rehabilitation services in health care institutions and processing documentation. Provided that the facilitation of communication topics of professional groups is established, it is possible to improve their functioning and attract more specialists to active participation.

**Key words:** communication, rehabilitation, virtual professional communities, social media

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## INTRODUCTION

Rehabilitation is recognized as one of the most important types of health care services at all stages of providing medical aid and care [1]. As governments and other interested parties take the lead in changing the way rehabilitation is perceived and prioritized, relevant policy interventions are increasingly being developed, but most of them do not recognize the role of rehabilitation services in achieving public health goals [2]. In the initiative "Rehabilitation 2030", WHO identified priority directions for strengthening rehabilitation, which also include strengthening mechanisms for planning and providing rehabilitation services at the subnational level, creating a large multidisciplinary contingent of rehabilitation specialists taking into account the specifics of each country, strengthening networks and partnerships in the field of providing rehabilitation services [3]. To ensure the above, measures are constantly implemented to improve the situation and scientific research is conducted. Research on the professional communication of rehabilitation service providers between themselves and other medical workers deserves particular attention. But most of the work in this

area involves formal communication between rehabilitation specialists and health professionals in an interdisciplinary team to coordinate medical care [4-6] and organizing effective communication between healthcare providers and patients [7-9].

In Ukraine, the process of strengthening rehabilitation in the health care system began recently, but it has already achieved certain progress in legislative provision and practical organization of rehabilitation in the system of health care [10]. But, taking into account the COVID-19 pandemic and Russia's armed aggression against Ukraine, informal virtual professional communication of various specialists with the help of modern information and communication channels has gained special development in the country. This did not go unnoticed by rehabilitation specialists and plays a certain role in providing information in the field of rehabilitation care and improving the qualifications of specialists. The advantages and disadvantages of virtual communication of health care professionals of various specialties and their use of social media to create virtual professional communities have already been repeatedly studied in the world [11-15].

Taking into account the constant development of the rehabilitation course in Ukraine and the circumstances that lead to the limitation of live communication, it is relevant to study the extent of the use of such virtual communication by rehabilitation specialists and its significance for their practical activities.

## AIM

The aim of the research is to investigate the scope, forms and activeness of informal professional communication of rehabilitation specialists using information and communication channels and its significance for their practical activities.

## MATERIALS AND METHODS

The following methods were used during the research: sociological; statistical; structural and logical analysis; generalization. Copies of the author's original sociological survey questionnaire were used as research materials. The questionnaire included the following components: introduction (addressing to the respondent, informed consent to participate in the study, instructions for filling in); main part with questions about respondents' participation in virtual professional communication groups, existent and desired content of information and communication channels; cluster of questions on socio-demographic and professional characteristics of respondents. Questionnaires were created using the tools of Google Workspace package (Google forms). During the research, a total of 185 rehabilitation specialists who are involved in informal communication through information and communication channels were interviewed. After removing invalid questionnaires, data from 178 completed questionnaires were analysed. Processing of the results was carried out with determination of relative values in percentages. The reliability of the results was assessed using standard methods (average error of the relative value ( $m$ ), coefficient of reliability of the differences ( $p$ ) of relative values according to the Student's criterion). Calculations were made using licensed software using Google Workspace packages (Google sheets) and Microsoft Office Excel 10 descriptive statistics. The survey was conducted in 2022.

## RESULTS

Analysis of the demographic characteristics of the study participants found out that the average age of rehabilitation specialists lay within  $45.1 \pm 12.5$  years. The distribution of respondents by gender showed that 18.0% of the respondents were male and 82.0% were female. Regarding the place of residence, the majority of the study group consisted of urban residents – 97.8%. Professional structure of the group: 62.9% – respondents with medical specialties (doctors of physical and rehabilitation medicine, doctors of exercise therapy, physiotherapists); 32.6% of respondents work in specialty 227 “Physical Therapy, Occupational Therapy”; 4.5% – “Nursing” and “Psychology”. In order to establish the difference in the answers to certain questions, the general research group was further divided into 2 subgroups: A (respondents with medical specialties) and B (respondents

with the specialties “Physical Therapy, Occupational Therapy”, “Nursing”, “Psychology”).

The analysis of the survey results revealed that absolutely all interviewed rehabilitation specialists consider it useful to create virtual groups for professional communication with colleagues in the field of rehabilitation through modern information and communication channels (social networks, messengers). However,  $22.5 \pm 3.1\%$  of them indicated that they see the benefit of such communication only in separate groups or separate social networks and messengers.

When determining the most convenient information and communication channels for professional communication with colleagues, their distribution by priority was found (Figure 1). It should be noted that the respondents could choose several channels for communication. So, the surveyed rehabilitation specialists identified social messengers as the most convenient for communication: Viber ( $85.4 \pm 2.6\%$ ) and Telegram ( $74.2 \pm 3.3\%$ ).

The next step was to analyse the answers of the study participants regarding the number of virtual communication groups with colleagues to which they are connected. Thus,  $16.8 \pm 2.8\%$  of respondents reported one group of communication,  $34.8 \pm 3.6\%$  – two groups,  $25.8 \pm 3.3\%$  – three groups,  $10.1 \pm 2.3\%$  – four groups and  $12.4 \pm 2.5\%$  – five or more.

The engagement of rehabilitation specialists in communication groups was determined by the level of viewing messages and participation in communication.  $44.9 \pm 3.7\%$  reported getting acquainted with the informational content of communication groups several times a day,  $36.0 \pm 3.6\%$  reported viewing it once a day,  $19.1 \pm 2.9\%$  reported viewing it once every few days.

However, half of the respondents ( $52.4 \pm 3.7\%$ ) only view the content of the information and communication channel, and  $47.2 \pm 3.7\%$  of participants discuss various topics:  $43.8\%$  of them rarely do this, and only  $3.4\%$  – often (Figure 2).

A detailed analysis revealed that the majority of rehabilitation specialists of medical specialties (subgroup A) only view the available content of the information and communication channel. This was reported by  $58.9 \pm 4.6\%$  of the participants of subgroup A. The interviewed specialists of subgroup B are more active, as  $57.6 \pm 6.1\%$  of them indicated the practice of discussion in communication groups, in contrast to subgroup A ( $41.1 \pm 4.6\%$ ), which was confirmed at a reliably significant level ( $p < 0.05$ ).

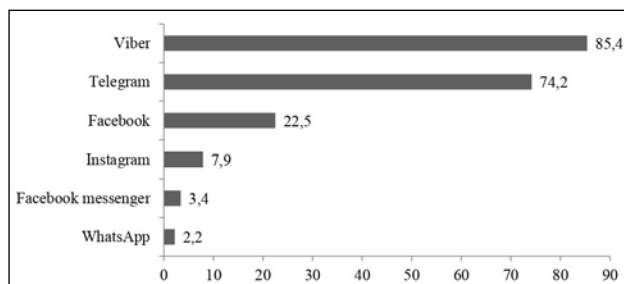
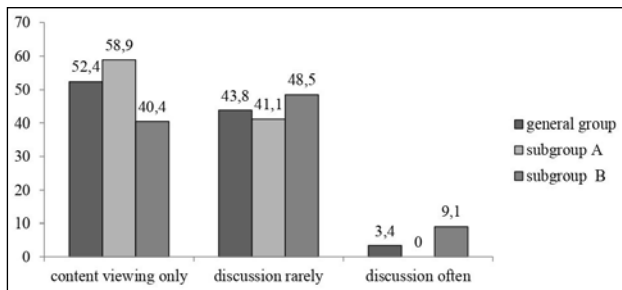


Figure 1. Distribution of priority information and communication channels for informal professional communication of rehabilitation specialists (%)



**Figure 2.** Engagement of respondents in informal professional communication groups (%)

It was discovered that  $44.9 \pm 3.7\%$  of respondents identified themselves as passive members of the group, who do not offer topics for discussion at all, and  $44.9 \pm 3.7\%$  as inactive (rarely offer topics for discussion). Only  $2.2 \pm 1.1\%$  of surveyed professionals were identified as active users. It should be noted that  $7.1 \pm 1.9\%$  do not remember whether they offered topics for discussion during the entire period of using communication groups.

The study participants were asked to identify topics that are most often discussed in groups and topics that, in their opinion, are more interesting for communication (Table 1).

It was determined that most often in the groups, the issues of correct preparation of documentation when providing services under the packages of the National Health Service of Ukraine (NHSU) ( $78.7 \pm 3.1\%$ ) and the problems of organizing the provision of rehabilitation services in health care facilities ( $74, 2 \pm 3.3$ ) were discussed, and most rarely - issues of modern diagnostic methods in the field of rehabilitation medicine ( $39.3 \pm 3.7\%$ ) and the issues of the amount of salary by position ( $29.2 \pm 3.4\%$ ). A more detailed analysis of the answers showed that a number of topics are considered by the interviewed rehabilitation specialists to be discussed more often:

- Issues of activities and means of professional development – 1,4 times ( $p < 0,001$ );
- Issues of modern diagnostic methods in the field of rehabilitation medicine – 1,9 times ( $p < 0,001$ );

- Issues of modern rehabilitation methods for various pathologies – 1,8 times ( $p < 0,001$ ).

Despite the potency in forming the content of information and communication channel on rehabilitation issues,  $98.9 \pm 0.8\%$  of the study participants consider the information received in such communication groups to be useful for professional clinical activities in the field of rehabilitation. At the same time, only  $39.3 \pm 3.7\%$  of respondents noted that the specified information is very useful to them, for  $49.4 \pm 3.7\%$  the information contains only useful elements, and  $10.1 \pm 2.3\%$  of the surveyed specialists indicate on the sporadic nature of useful information.

The formation of content can also be influenced by the professional composition of the group of informal virtual communication. Therefore, the research participants were asked to choose the optimal composition of the virtual community in their opinion, with the participation of specialists exclusively or mixed groups (Table 2).

It was discovered that more than half of all research participants ( $56.2 \pm 3.7\%$ ) consider the virtual community consisting only from specialists in the field of rehabilitation (doctors of physical and rehabilitation medicine, doctors-physiotherapists, doctors of exercise therapy, physical therapists, occupational therapists, nurses, speech and language therapists, psychologists) to be the most effective for professional communication. Almost a third of the total research group ( $32.6 \pm 3.5\%$ ) considers it more appropriate to communicate in a joint group of healthcare management specialists and rehabilitation specialists. No significant difference was found in the answers of the respondents divided by subgroups in the study.

## DISCUSSION

The use of social networking sites facilitates effective communication between healthcare professionals and has benefits in terms of information dissemination, professional networking and collaboration [11]. In the United Kingdom, a large number of doctors and nurses use social media to access online medical forums for further education [12]. In

**Table 1.** Distribution of respondents' answers regarding existent and desired topics for discussion in professional communication groups (%)

| Discussion topic  | Answers (n=178) |          | Reliability of difference |
|---|-----------------|----------|---------------------------|
|   | Existent        | Desired  |                           |
| Problems of organizing the provision of rehabilitation services in health care facilities | 74,2±3,3        | 73,0±3,3 | p>0,05                    |
| The issue of financing rehabilitation services through the NHSU                           | 41,6±3,7        | 36,0±3,6 | p>0,05                    |
| The issue of the amount of salary by position   | 29,2±3,4        | 28,1±3,4 | p>0,05                    |
| The issue of correct preparation of documentation when implementing the NHSU packages     | 78,7±3,1        | 80,9±2,9 | p>0,05                    |
| Issues of activities and means of professional development                                | 48,3±3,7        | 66,3±3,5 | p<0,001                   |
| Issues of modern diagnostic methods in the field of rehabilitation medicine               | 39,3±3,7        | 73,0±3,3 | p<0,001                   |
| Issues of modern rehabilitation methods for various pathologies                           | 50,6±3,7        | 88,8±2,4 | p<0,001                   |



**Table 2.** Distribution of respondents' answers regarding the priority professional composition of the virtual community (%)

| Professional composition of a communication group   | Answers               |                    |                   |
|---|-----------------------|--------------------|-------------------|
|   | General group (n=178) | Subgroup A (n=112) | Subgroup B (n=66) |
| Management and rehabilitation professionals (heads of rehabilitation health care facilities, heads of rehabilitation departments, physical therapists, occupational therapists, nurses)   | 32,6±3,5              | 35,7±4,5           | 27,3±5,5          |
| Specialists only in the field of rehabilitation (doctors of physical and rehabilitation medicine, doctors-physiotherapists, doctors of exercise therapy, physical therapists, occupational therapists, nurses, speech and language therapists, psychologists) | 56,2±3,7              | 57,1±4,7           | 54,5±6,1          |
| Specialists in only one specialty (only doctors, only physical therapists, nurses, physical therapist assistants, occupational therapist assistants, speech and language therapists only, etc.)   | 4,5±1,6               | 1,8±1,3            | 9,1±3,5           |
| Management and rehabilitation professionals, as well as social workers and patients with long-term rehabilitation needs   | 6,7±1,9               | 5,4±2,1            | 9,1±3,5           |

the USA 88.0% of doctors and nurses were found to use social media and 10.4% of doctors indicated that they participate in medical forums online [13]. However, over the past 5 years, the situation with the development of information and communication technologies has developed significantly. Our research shows that absolutely all interviewed rehabilitation specialists consider it useful to create virtual groups for professional communication with colleagues in the field of rehabilitation through modern social media. This is also explained by the fact that, by creating professional networks, social media unite professionals beyond the geographical location of their usual practices [11]. Healthcare professionals in many countries have begun to use social media to create viable virtual professional communities [14], which has ensured rapid progress in their development worldwide to improve evidence-based practice and clinical outcomes in healthcare [15].

But it has already been repeatedly denoted that virtual communities can have observers, passive and active participants [14, 16]. In our study, it was found that 44.9±3.7% of rehabilitation specialists recognize themselves as passive participants in virtual communication groups, and 47.1±3.7% are active to varying degrees, which confirms the above statement.

Despite the activeness in the formation of the content of information and communication channels on rehabilitation issues, only half of the participants of virtual groups, 98.9±0.8% of the study participants consider the information received in such communication groups to be useful for professional clinical activities in rehabilitation.

Often, clinicians prefer to use social media that allow them to communicate within their profession and clinical specialty [14]. The majority of the participants in our study (56.2±3.7%) also see the most effective organization of virtual professional communication within one sphere - rehabilitation. However, 32.6±3.5% of participants still wanted to involve health care managers in virtual communication groups. This is probably related to the modern health care reform in Ukraine, the active development of rehabilitation and the introduction

of new organizational models in providing rehabilitation services to the population.

It should be noted that the majority of the interviewed rehabilitation specialists (88.8±2.4%) still consider sharing the experience and gaining new knowledge regarding modern methods of rehabilitation for various pathologies as a priority direction for communication. This indicates a desire to constantly improve one's qualifications, grow professionally and provide quality rehabilitation services. Given that at the time of the survey, the specified topic was less often discussed in virtual groups, it would be a good recommendation to strengthen the role of administrators in facilitating professional communication on the topics most interesting to participants.

## CONCLUSIONS

The research demonstrated a high level of participation of rehabilitation specialists in informal virtual communication using information and communication channels. The development of virtual professional communities of rehabilitation specialists helps them to exchange information and improve their knowledge in matters of organizing the provision of rehabilitation services in health care facilities and processing documentation. Provided that the facilitation of communication topics of professional groups is established, it is possible to improve their functioning and attract more specialists to active participation.

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**ADDRESS FOR CORRESPONDENCE:**

**Valeriya Brych**

Uzhhorod National University

14 University St., 88000 Uzhhorod, Ukraine

e-mail: valeria.bruch@uzhnu.edu.ua

**ORCID ID and AUTHORS CONTRIBUTION**

0000-0003-3741-6002 – Valeriya Brych (A, B, C, D, E, F)

0000-0002-2737-960X – Mariana M. Dub (A, B, C)

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



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# Systematization of Degrees of Complexity and Objectification of Clinical Assessment of Dysphagia of Oral and Oropharyngeal Stages of Swallowing

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**Anna Kushta, Sergii Shuvalov**

National Pirogov Memorial Medical University, Vinnytsia, Ukraine

**SUMMARY**

**Aim:** Global monitoring of the incidence shows that oral and pharyngeal cancer is one of the most common cancers in the world. Treatment of such patients, regardless of its type (surgical, radiation, chemotherapy) is quite traumatic, which leads to damage to surrounding tissues, disruption of their functions and before swallowing. Objectification of the severity of functional disorders is difficult in both the first and second phases of swallowing. There is also no systematization of severity, which could be used in the clinic in such patients. The aim of the work was to select and evaluate methods for diagnosing swallowing disorders and systematization of oral and oropharyngeal dysphagia.

**Materials and Methods:** The study included 36 patients aged 38-55 years (men) who were treated in the Department of Head and Neck Tumors „Podolsk Regional Oncology Center” with malignant tumors of the tongue, bottom of the mouth and oropharynx stage I-III. All patients had problems with chewing and swallowing. A comprehensive method of assessing the effectiveness of chewing and ultrasound examination of the act of swallowing, the presence of the pain component on the visual-analog scale (VAS) at the time of hospitalization and in the postoperative period for 10 days.

**Results:** Clinical and ultrasound studies have shown a reduction in muscle contraction in all patients, regardless of the location of the process. Changes were observed depending on the clinical course of the disease, the prevalence of the tumor and the volume of the muscles being incised. There was a tendency that patients who could not mix and form the food bolus were also unable to take a normal sip. These manipulations were accompanied by varying intensity of pain. Based on the obtained data, groups of patients by severity and their systematization were formed.

**Conclusions:** The systematization of oral and oropharyngeal dysphagia on the basis of objective indicators is proposed (masticatory efficiency – masticatory test, ultrasound examination). To assess the first phase of swallowing, a set of studies with three methods is recommended: 1 – chewing test; 2 – visual-analog scale of pain; 3 – ultrasound examination. To assess the second phase of swallowing – two methods: 1 – visual-analog scale of pain; 2 – ultrasound examination. The transfer of the patient from the tube feeding to the usual was carried out on the basis of the obtained objective indicators, taking into account subjective data as auxiliary.

**Key words:** chewing, chewing test, swallowing, ultrasound examination, degree of dysphagia, oncopathology, postoperative defect

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**INTRODUCTION**

The incidence of head and neck cancer is growing steadily and is characterized by high mortality. Global monitoring of the incidence shows that oral and pharyngeal cancer is one of the most common cancers in the world and ranks eighth among all localizations, corresponding to 2.5 per 100,000 cancers [1]. According to the National Cancer Registry of Ukraine (2019), head and neck tumors account for up to 20% of all oncopathologies. The most commonly diagnosed are oral cancer, which is 9.6 cases per 100,000 population, laryngeal cancer – 5.7, lip cancer – 4.1, pharyngeal cancer – 4.2 [2]. Treatment of such patients, regardless of its type (surgical, radiation, chemotherapy) is quite traumatic, which leads to damage to surrounding tissues, dysfunction and, above all, swallowing.

In the preoperative and postoperative period, dysphagia is present in almost every patient with this pathology and is 90-95%. Between 40 and 67% of patients with dysphagia (Daniels et al, 1998) have so-called “silent aspiration”. It complicates its timely diagnosis and leads to the development of aspiration and pneumonia [3].

Problems with swallowing in cancer of the oral cavity and oropharynx may be associated primarily with the type and size of the tumor itself, which impairs the ability to eat. Difficulties in pushing a food lump develop due to dysfunction of the affected muscles or damage to peripheral nerves. Major anatomical defects occur as a result of surgery. Functionally important muscles and, in some cases, jaw fragments are included in the unit with the tumor removed [4].

## AIM

There are also disorders of normal swallowing in radiation and chemoradiation therapy of the oral cavity, oropharynx, pharynx and larynx [5].

In the act of swallowing there are three phases that can be violated [6]. The first involves the difficulty of forming a food lump in the mouth and moving it towards the root of the tongue. The second, which is associated with difficulty in the beginning of swallowing movements (oropharyngeal dysphagia). In this paper, we do not consider the problem of moving the breast through the esophagus into the stomach (esophageal dysphagia), which is the third phase of swallowing.

Oral and pharyngeal dysphagia is the biggest problem for maxillofacial surgeons and dental surgeons, otolaryngologists and oncologists. We have identified two groups of causes of oropharyngeal dysphagia: structural changes and neuromuscular disorders. Structural changes included inflammation of the mucous membranes of the oral cavity and oropharynx, the presence of tumors and foreign bodies. Neuromuscular disorders included postoperative changes (defect, resected muscles and nerves of the mouth and oropharynx), as well as certain neurological conditions (bulbar and pseudobulbar syndromes, brain tumors, cerebrovascular, rarely degenerative diseases of the nervous system, extrastratic nervous system, peripheral neuropathy, Guillain-Barré syndrome), systemic connective tissue diseases, diphtheria, botulism, inflammation of the anterior horns of the spinal cord (polio), myasthenia and myasthenic syndromes, myopathy.

In neurological pathologies, diagnostic manipulations of swallowing disorders have been developed [7]. However, they are not informative for the study of swallowing in patients with postoperative defects. Objectification of the severity of functional disorders is difficult in the first and second phases of swallowing. Because it is necessary to take into account the grinding of food, the formation of food bolus and pushing into the esophagus.

In this article we considered only postoperative disorders of the oral cavity and oropharynx.

There are a number of static and dynamic measurement methods for determining masticatory efficiency. When using static methods, the coefficients of functional significance of each tooth are used. Dynamic methods involve direct chewing tests on SE Gelman, I.S. Rubinov, chewing effect according to OM Ryahovsky [8]. However, the use of such direct methods is time consuming. This has led to the creation of indirect methods for assessing masticatory efficiency [9, 10].

There are instrumental methods for the study of swallowing (video fluoroscopy, radiography, fibro-optical endoscopy). But they are traumatic for patients with postoperative defects of the oral cavity [11].

Therefore, it is necessary to systematize oral and oropharyngeal dysphagia on the basis of objective studies acceptable in patients with tumors or postoperative defects of the oral cavity and oropharynx. After all, due to the location of the tumor in the upper digestive tract, it creates a mechanical problem. That is, its size, volume, location, and invasion prevent it from eating. This in turn can lead to postoperative disorders.

The aim of the study was to select and evaluate methods for diagnosing swallowing disorders and systematization of oral and oropharyngeal dysphagia.

## MATERIALS AND METHODS

The study included 36 patients aged 38-55 years (men), with 8-12 occlusal pairs of teeth. Patients were treated in the Department of Head and Neck Tumors of the Podolsk Regional Oncology Center with malignant tumors of the tongue, bottom of the mouth and oropharynx stage I-III. All patients had problems with chewing and swallowing. This is typical of patients with tumors of the following localization (cancer of the tongue - 16, the mucous membrane of the oral cavity - 12 and the alveolar process of the mandible - 8). Patients with stage IV were not included in the study. They only needed palliative care. Surgical treatment was performed in the amount of resection of the oral and oropharyngeal organs with plastic surgery with local tissues.

A comprehensive method for assessing the effectiveness of chewing and breast formation has been developed and applied. The formation of food lumps was determined by chewing efficiency (chewing test). Swallowing - on ultrasound. The amplitude of contraction of the supralingual muscle group, which takes into account the oropharyngeal and pharyngeal phases of swallowing, was determined.

Determination of masticatory efficiency and ultrasound examination of the act of swallowing, the presence of a pain component on the visual analog scale (VAS) in the patient was performed at the time of hospitalization and in the postoperative period for 10 days.

The chewing test was performed using Orophys Huechek gum (Switzerland). It is based on mixing erasers of two colors in 20 chewing movements. The eraser was placed in a plastic bag and leveled to a thickness of 1 mm. A 24-hour color grading scale or software was used to assess chewing efficiency. Benefits include speed of manipulation, ease of interpretation with computer software, and long-lasting results. This is positive for comparing chewing efficiency in dynamics [12]. According to the proposed computer analysis, the values of the mixed particle less than 0.5 indicate poor mixing and bolus formation, from 0.5 to 0.75 to moderate, from 0.75 to 0.9 - good and more than 0.9 - excellent mixing erasers and bolus formation.

Ultrasound examination of the act of swallowing was performed in two modes B and M. B-mode - a fixed image frame and M-mode - an image in motion. In the B-mode, the chin-sublingual distance, longitudinal and transverse measurements of the sublingual muscle group were determined. In M-mode - longitudinal examination of the sublingual muscle group. The study was performed at rest and while swallowing.

VAS take into account 7 types of pain intensity and 10 points: 0 - no pain; 1 - pain is barely noticeable; 2-3 - weak; 4-5 - moderate; 6-7 - strong; 8-9 - very strong; 10 - unbearable pain.

Statistical processing of the obtained data was performed using a mathematical statistical method on a PC using



Excel software from Microsoft Office 2003, STATISTICA 5.5 (owned by of VNMU named after MI Pirogov, licensed № AXXR910A374605FA) according to Mann–Whitney U test. Differences between groups were considered statistically significant at  $p < 0.05$ .

### RESULTS

Images of masticatory samples and ultrasound were analyzed. In order to assess the effectiveness of chewing for each patient, the mixed proportion of the two colors after 20 cycles of chewing was calculated (Table 1).

The study indicates that in patients with cancer of the tongue (stage I-III) and cancer of the mucous membrane of the oral cavity (stage III), the formation of bolus before surgery is moderate and was in the range of  $0.69 \pm 0.03 - 0.76 \pm 0.04$ . Patients with cancer of the mucous membrane of the oral cavity (stage I, II) and alveolar process of the mandible (stage I-III) had good mixing and pain formation ( $0.78 \pm 0.04 - 0.92 \pm 0.04$ ). Similar changes were observed on the 10th

day. The worst mixing and bolus formation was observed in patients in the postoperative period with cancer of the tongue (stage I-III) and cancer of the mucous membrane of the oral cavity (stage III), was in the range of  $0.24 \pm 0.03 - 0.34 \pm 0.04$ , which corresponds to poor mixing. In patients with cancer of the mucous membrane of the oral cavity (stage II-III) and cancer of the alveolar process of the mandible (stage I-III), moderate mixing of the bolus was observed ( $0.61 \pm 0.03 - 0.78 \pm 0.04$ ).

Barely noticeable pain during chewing in the postoperative period was noted in patients with cancer of the tongue (stage I-II) and cancer of the mucous membrane of the oral cavity (stage I-II). Mild pain was noted in patients with stage III cancer of the tongue and stage I alveolar process of the mandibular process. Patients with stage III cancer of the mucous membrane of the oral cavity and mandibular alveolar process cancer (stage II-III) complained of moderate pain during chewing

**Table 1.** Values of masticatory parameters (MP) for 20 masticatory cycles and VAS ( $n = 36$ ,  $M \pm m$  before surgery and on 10 days after, k-mixed fraction of MP)

| Diagnosis  | Cancer of the tongue (n=16) |           |           | Cancer of the mucous membrane of the oral cavity (n=12) |           |           | Cancer of the alveolar process of the mandible (n=8) |           |           |
|--|-----------------------------|-----------|-----------|---|-----------|-----------|--|-----------|-----------|
|  | I                           | II        | III       | I   | II        | III       | I  | II        | III       |
| MP before the operation<br>k- average ( $M \pm m$ )  | 0,76±0,04                   | 0,72±0,04 | 0,69±0,03 | 0,89±0,04   | 0,78±0,04 | 0,73±0,04 | 0,92±0,04  | 0,87±0,04 | 0,82±0,04 |
| MP 10 days after surgery<br>k- average ( $M \pm m$ ) | 0,34±0,04                   | 0,28±0,03 | 0,24±0,03 | 0,78±0,04   | 0,61±0,03 | 0,42±0,04 | 0,75±0,04  | 0,72±0,04 | 0,68±0,03 |
| VAS (points) when chewing for 10 days                | 0,3±0,1                     | 0,6±0,2   | 2,4±0,6   | 0,9±0,3   | 1,1±0,4   | 4,8±0,2   | 3,6±0,2  | 4,8±0,2   | 5,3±0,3   |

**Table 2.** Indicators of muscle contraction in the B- and M-mode in patients with oncopathology of the oral cavity and VAS ( $n = 36$ ,  $M \pm m$  before surgery and on 10 days after)

| Diagnosis   | Longitudinal projection of the supralingual muscle group (mm), M-mode |            | Longitudinal projection of the supralingual muscle group (mm), B-mode |            | Chin-sublingual distance (mm) |            | VAS (points) when swallowing |
|---|---|------------|---|------------|-------------------------------|------------|------------------------------|
|   | rest  | swallow    | rest  | swallow    | rest                          | swallow    |                              |
| Cancer of the tongue before- (n=16)                             | 11,42±0,91  | 8,42±0,61  | 12,11±0,91  | 8,92±0,72  | 39,72±3,23                    | 31,32±2,12 | 1,6±0,4                      |
| Cancer of the tongue after- (n=16)                              | 11,0±0,82   | 8,93±0,54  | 12,0±0,91   | 10,94±0,82 | 39,73±3,24                    | 33,42±2,73 | 2,3±0,6                      |
| Cancer of the mucous membrane of the oral cavity before- (n=12) | 11,85±0,93  | 10,92±0,63 | 11,43±0,82  | 10,25±0,55 | 38,37±3,41                    | 34,33±3,11 | 2.2±0,5                      |
| Cancer of the mucous membrane of the oral cavity after- (n=12)  | 10,83±1,14  | 9,92±0,75  | 10,91±0,27  | 10,44±0,55 | 38,73±3,42                    | 35,0±2,91  | 4,6±0,2                      |
| Cancer of the alveolar process of the mandible before - (n=8)   | 10,83±0,52  | 9,15±0,33  | 10,92±0,74  | 9,82±0,56  | 37,21±3,33                    | 33,34±2,51 | 0,7±0,2                      |
| Cancer of the alveolar process of the mandible after- (n=8)     | 10,21±0,33  | 8,48±0,42  | 10,34±0,65  | 9,56±0,53  | 37,0±3,23                     | 35,11±2,22 | 1,1±0,3                      |

The following indicators were obtained by ultrasound examination of the act of swallowing (Table 2).

The study showed a reduction in muscle contraction in all patients, regardless of the location of the process. Changes were noted depending on the prevalence of the disease and the volume of resected muscles.

Indicators of muscle contraction with localization of the process on the the tongue and alveolar process of the mandible for 10 days almost corresponded to the initial values before surgery. This indicates that in patients in the postoperative period for 10 days with cancer of the tongue and cancer of the alveolar process of the mandible resumed the act of swallowing. These patients can switch from nasogastric nutrition to independent. On the 10th day, their nasogastric tube was removed. In patients with cancer of the mucous membrane of the oral cavity, the difference was 1.03 mm. A decrease in the amplitude of contraction of the muscles of the supralingual group in longitudinal projection was revealed. These patients were on tube feeding for up to 14-15 days.

When swallowing, attention was paid to the severity of pain before and after surgery. Patients with cancer of the alveolar process of the mandible (stage I-III) had barely noticeable pain ( $0.7 \pm 0.5$  before surgery and  $1.1 \pm 0.2$  after surgery). Patients with cancer of the tongue (stage I-III) reported mild pain ( $1.6 \pm 0.4$  before surgery and  $2.3 \pm 0.6$  after surgery). Patients with cancer of the mucous membrane of the oral cavity (stage I-III) - before surgery noted mild pain ( $2.2 \pm 0.4$ ), and after surgery moderate ( $4.6 \pm 0.6$ ).

There was a trend - patients who could not mix and form a bolus also could not take a normal sip. These manipulations were accompanied by varying intensity of pain.

By grouping these indicators, we propose to objectify the assessment of oral and oropharyngeal dysphagia. There are 3 degrees of its severity: 1 degree - difficulty chewing food processing, good formation of food lumps (0.75-1.0) and swallowing with minimal effort (the difference between the rates of swallowing before and after surgery - 6-8 mm); 2 - difficulty chewing food processing, moderate formation of food lumps (0.5-0.75) and swallowing with great effort (the difference in the rate of ingestion of swallowing before surgery and after - 2-4 mm); 3 - inability to chew food, poor formation of food lumps (<0.5) and swallowing is almost impossible (amplitude of muscle contraction from baseline -  $\leq 2$ mm). Swallowing even gel-like food is difficult, it is an indication to continue nasogastric nutrition.

The group with 1 degree of oral and oropharyngeal dysphagia consisted of 16 patients with cancer of the tongue and cancer of the alveolar process of the mandible. These are patients with a small volume of resected soft tissue sections without transitioning to the pterygopalatine fold and regardless of the presence of the resected jaw.

The group with grade 2 oral and oropharyngeal dysphagia consisted of 14 patients with cancer of the tongue and cancer of the mucous membrane of the oral cavity. Patients had a large volume of resected tissues with a transition from the pterygopandibular convolution to the pharyngeal-epiglottis, regardless of the presence of the resected jaw.

The group with grade 3 oral and oropharyngeal dysphagia consisted of 6 patients with cancer of the root of the tongue. Patients with a large volume of resected tissues 2-3 anatomical areas with a transition to the pterygopalatine and pharyngeal-epiglottis convolutions. This makes the act of swallowing virtually impossible without reconstructive surgery, without replacing the defect with arterialized skin and muscle flap.

## DISCUSSION

The study of masticatory efficiency and the act of swallowing in patients with oncopathology of the oral cavity and oropharyngeal is of great importance in assessing the functional state of the oral cavity and pharyngeal. In patients with tumors of the oral cavity and oropharynx before swallowing the tumor swallowing is already impaired and does not provide adequate nutrition. Functional disorders are visible at the initial examination of the patient. Once the tumor is removed, along with nearby muscles, swallowing becomes impossible (patients are on a tube feeding).

We have noted that the extent of soft tissue defects is more important than the presence of dentition and jaw defects.

N. Kingsley, 1880, pointed out the adaptive capacity of the human dental and maxillofacial system. Analyzing the defects of the dentition, arguing that the presence of 6 teeth from the oral cavity is sufficient for chewing food: is important for grinding and chewing food [13].

The absence of certain groups of teeth is an important factor in the formation of the food bolus. However, the presence of 8-10 teeth on the upper and lower jaws is sufficient for satisfactory grinding and chewing, with a mixed fraction of up to 0.75.

Significant disorders of the shape, the ratio of soft tissues are insufficient contact of the tip of the tongue and palate, the mucous membrane of the cheek and lateral surfaces of the tongue with the tissues of the throat, crossing the resection of the pterygopalatine and pharyngo-pharyngeal folds.

## CONCLUSIONS

1. The proposed systematization of oral and oropharyngeal dysphagia on the basis of objective indicators (masticatory efficiency - chewing test, ultrasound) is informative.
  2. To evaluate the first phase of swallowing, a set of studies with three methods is recommended: 1 - chewing test; 2 - visual-analog scale of pain; 3 - ultrasound examination.
  3. To assess the second phase of swallowing - two methods: 1 - visual-analog scale of pain; 2 - ultrasound examination.
- Transfer of the patient from the nasogastric nutrition to the usual is carried out on the basis of objective indicators and degrees of oral and oropharyngeal dysphagia.

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**ADDRESS FOR CORRESPONDENCE:**

**Anna Kushta**

Maxillo-facial, National Pirogov Memorial Medical University,  
Vinnitsya, Ukraine  
email: dr\_anna9@ukr.net

**ORCID ID and AUTHORS CONTRIBUTION**

0000-0001-8994-2560 – Anna Kushta (A, B, C, D, E, F)

0000-0001-5052-680X – Sergii Shuvalov (A, E, F)

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



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# Formation and Preservation of Students' Mental Health in the Process of Studying at Pedagogical Universities

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Gregory Griban<sup>1</sup>, Serhii F. Kudin<sup>2</sup>, Hanna I. Zhara<sup>2</sup>, Andrii V. Kuzhelnyi<sup>2</sup>, Tamara V. Mazur<sup>3</sup>, Yuliya M. Nosko<sup>2</sup>, Olha B. Mekhed<sup>2</sup>

<sup>1</sup>Zhytomyr Ivan Franko State University, Zhytomyr, Ukraine

<sup>2</sup>T.H. Shevchenko National University „Chernihiv Colehium”, Chernihiv, Ukraine

<sup>3</sup>K.D. Ushynskiy Chernihiv Regional Institute of Postgraduate Pedagogical Education, Chernihiv, Ukraine

## SUMMARY

**Aim:** The aim is to experimentally verify the methodology of self-regulation culture formation as an important element of professional training of future teachers of the humanities in the process of studying the author's specialized course referred to as "Fundamentals of Psychovaleology".

**Materials and Methods:** The research involved third-year students of pedagogical institutions of higher education aged 20 to 23 years in the number of 126 people (80 girls and 46 boys). The methods used included observation, questionnaires, psychodiagnostic methods for determining the level of anxiety, self-assessment of well-being, quantitative and qualitative analysis of the results in terms of self-regulation culture formation according to theoretical, practical and professional criteria.

**Results:** Experimental verification of the effectiveness of the developed methodology shows qualitative positive changes in the students' emotional well-being, in significant reduction of their anxiety, as well as in increasing motivation for active exercise

**Conclusions:** The developed methodology of self-regulation culture formation in future teachers can become a significant basis for the further formation of individual health preservation competence of students i. e. future teachers, their orientation to active physical education as well as fitness and health recreation activities, and can also be included in the system of implementation of professional standards for the training of students in pedagogical specialties, especially in terms of the development of their health preservation competence

**Key words:** self-regulation culture, psychovaleology, health preservation competence, individual health preservation competence, future teacher

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## INTRODUCTION

The problem of preserving the health of children and youth in modern conditions of development of Ukrainian society is of exceptional importance and relevance. It is the sustainable orientation of the individual towards physical culture and sports activities, the formation of the need for a healthy lifestyle that is considered today as one of the priority areas of education [1-3]. The strategic state measures in this direction include the implementation of the State Targeted Social Program for the Development of Physical Culture and Sports for the period up to 2024, the National Strategy for Recreational Motor Activity in Ukraine for the period up to 2025 referred to as "Motor Activity – Healthy Lifestyle – Healthy Nation", the National Program of Mental Health and Psychosocial Support (2022) and others. All of them in one way or another ensure the formation of a valuable attitude of young people to their own health, improvement of physical development and physical fitness, taking into account the requirements of

future professional activities, mastering quick methods of psychological support, awareness of the importance of maintaining the mental health of all participants in the educational process. For teachers and students who aspire to become teachers, the priority task is to lead a healthy lifestyle and provide an example of health preservation for high schoolers [4, 5]. Therefore, it is important to form health preservation competence of the future teacher as a system, as well as its integral component i. e. the competence of individual health preservation of the teacher.

The analysis of psychological and pedagogical literature shows that much attention is paid to the formation of valeological consciousness and valeological thinking [1, 4, 6]. According to scientists [2, 7], preserving the health of the population as a whole, maintaining working capacity and ensuring the active longevity of each individual are the priority tasks of modern social policy in many countries. Scientists associate the implementation of the idea of health preservation through the educational space with



the improvement of the content of teacher education, the development of effective criteria for determining its effectiveness [8]. Therefore, the most important indicators of the effectiveness of the educational process include health preservation competence formedness in future teachers, on the one hand, as a prerequisite for ensuring their professional longevity and predictability of the results of specialists' activities, and on the other – as the basis for preserving and promoting high schoolers' health. After all, numerous negative risk factors, which, unfortunately, often occur in the educational process, lead to a deterioration in the somatic and mental health of all its participants [9, 10].

In the context of professional pedagogical training, self-regulation culture, which lays the foundation for further professional success is one of the important indicators of individual health preservation competence of future teachers and an indicator of their readiness for health preservation pedagogical activities [6, 11]. The teacher's ability to self-regulation is considered as a necessary condition for the prevention of mental disorders and productive solution of professional problems, including in the management of the educational process [4, 12]. Self-regulation can also be considered as a tool of developing adaptability in the social and professional environment, which is the acmeological basis of pedagogical activities [13].

### AIM

The aim is to experimentally verify the methodology of self-regulation culture formation as an important element of professional training of future teachers of the humanities in the process of studying the author's specialized course referred to as "Fundamentals of Psychovaleology".

### MATERIALS AND METHODS

The research involved third-year students of the Faculty of Preschool, Primary Education and Arts; the Faculty of Philology and the O.M. Lazarevskiy Educational and Research Institute of History and Socio-Humanitarian Disciplines of the T.H. Shevchenko National University "Chernihiv Collegium" aged 20 to 23 years in the number of 126 people (80 girls and 46 boys). Two groups of interest were formed, which made up the experimental (EG) and the control (CG) groups, having an equal number of respondents (63 students).

The research used the methods of analysis and synthesis of literature, pedagogical observation, questionnaires, psychodiagnostic methods, quantitative and qualitative analysis of the results.

The methodology of self-regulation culture formation was developed for students of humanitarian specialties in order to acquire competencies in the theory and practice of self-regulation, the main components of which were determined by the corresponding aim, tasks, conditions of implementation, the necessary theoretical and practical content, a set of forms, methods and tools, criteria and levels of self-regulation culture formedness. The specialized course referred to as "Fundamentals of Psychovaleology" was the content basis of the methodology for self-regulation

culture formation [14]. The specialized course was designed for third-year students of the pedagogical university for one semester of study, a total of 60 hours, of which 32 hours are in-class learning. The educational material of the specialized course is combined into two content modules: "Formation of Mental Health" and "Preservation and Strengthening of Mental Health". Both modules are united by the cross-cutting concept of "mental health". The importance of this circumstance is explained by the fact that the mental state of a person is of great importance for a healthy full life, as it directly affects the ability of a person to learn, develop professionally, self-develop and be socially active. At the same time, much attention is paid to the formation of students' worldview beliefs about a healthy lifestyle as a way of life that is more effective than the activities of the medical industry related to the preservation and promotion of health.

The use of various forms (lectures, laboratory classes, workshops) and active teaching methods (dialogues, discussions, situational-communicative games, etc.) was one of the conditions for ensuring the practical implementation of the methodology. The professional orientation of the methodology was achieved by setting up students for systematic independent work in terms of optimization of their mental and physical condition, increase in their motor activity to prevent stressful conditions and maintain the general tone of the body.

In order to study the influence of self-regulation training on the change of students' individual sensitivity to stressors, the level of situational anxiety was determined by the method of Ch.D. Spielberger, adapted by Y.L. Khanin. At the same time, we proceeded from the fact that anxiety as a psycho-emotional state of a person characterizes his or her tendency to manifest emotional reactions of fear, fright, etc. in stressful situations. The optimal level of situational anxiety can be an indicator of a person's ability to control his or her psycho-emotional state.

To determine the effectiveness of the developed methodology of self-regulation culture formation in terms of its impact on the psycho-emotional state of students, the method of self-assessment of well-being (according to V.P. Ozerov) was used, according to which students had to evaluate their well-being on a 5-point scale: 5 – feeling better than usual; 4 – feeling good; 3 – feeling tired; 2 – feeling mild malaise; 1 – feeling sick.

The comprehensive assessment of the students' self-regulation culture formedness was determined by theoretical, practical and professional criteria. We developed the self-assessment map of theoretical knowledge, practical and professional skills formedness. The levels of self-regulation culture formedness were evaluated in points: high level was estimated at 3 points; average– 2 points; low – 1 point. The comprehensive assessment involved students who evaluated their theoretical knowledge, practical and professional skills and abilities to apply self-regulation methods. According to the same criteria and levels, the assessment of self-regulation culture formedness was carried out by the experts, who were teachers of valeological academic disciplines.

The self-regulation culture formedness was determined by the amount of changes that occurred in the learning process, which was statistically tested by Student's t-criterion.

## RESULTS

According to the results of the study of the dynamics of situational anxiety indicators of students, it was found that the students of both study groups had almost the same anxiety indicators (Table 1) at the beginning of the pedagogical experiment, while this indicator decreased almost twice in the EG students at the end of the experiment, and it remained unchanged in the CG students. The difference between the indicators of situational anxiety in the EG students at the beginning and at the end of the research is 6.14 points and is significant ( $p < 0.001$ ), and in the CG students the difference is 0.45 points and is not significant ( $p > 0.05$ ). At the same time, the level of anxiety of students of both groups at the beginning of the experiment was on the verge of optimal and high, and it decreased to the level of optimal and low at the end of the experiment, and the level did not change in the CG.

The obtained results of the dynamics of the indicators of situational anxiety of students indicate that after teaching students of the EG the basics of psychovalology according to the author's methodology, where they master the methods of self-regulation, there was a significant improvement in their ability to effectively resist stress factors due to the formation of psychological resilience, skills to counteract negative external factors. Instead, the results of the CG can be explained by the fact that students who do not have the tools of self-regulation can not always resist stressful factors.

The study of the level of well-being of the EG and the CG students showed significant differences between the comparison groups (Table 2).

The analysis of the test results showed that the students of both groups before the beginning of the pedagogical experiment had equally low indicators of their well-being, both groups were prevailed by students who assessed their condition at

the level of "feeling tired" indicator (the EG – 2.95 points; the CG – 3.07 points). The EG students significantly improved their well-being by 1.26 points ( $p < 0.001$ ) after mastering the techniques of self-regulation during the specialized course referred to as "Fundamentals of Psychovalology". Moreover, the vast majority of the EG students was characterized by the scores in the range of "feeling better than usual" and "feeling good". Also, the EG students noted their desire to increase the amount of motor activity i. e. various physical exercises, which indicates that students' mastery of self-regulation techniques contributed to the improvement of their emotional and general physical condition. In the CG, the indicators of well-being improved by 0.29 points, but the difference between the initial and final data was not significant ( $p > 0.05$ ); most CG students assessed their well-being at the level of "feeling tired".

The comprehensive assessment of self-regulation culture formedness was carried out in order to summarize the results, where its criteria and levels were determined. The criteria for self-regulation formedness were theoretical awareness, practical competence of the future specialist in matters of self-regulation, his or her ability to model possible stressful situations in future professional activities and quick orientation in choosing a set of various methods of self-regulation, based on each specific situation, while showing a creative approach. Taking into account these criteria, the EG and the CG students were divided into 3 subgroups: with high, average and low level of self-regulation culture formedness (Table 3).

According to the developed criteria, three levels of adaptation and health effects were identified, which characterize the practical component of self-regulation culture formedness: high, average, low. Students who do not wait for outside help to resolve a difficult conflict situation and find the right solution have a high level. Students who have this level of self-regulation culture do not enter into conflict relationships, are able to organize their activity so that it would provide benefit to themselves and others and

**Table 1.** Dynamics of the indicators of situational anxiety of the EG and the CG students during the pedagogical experiment ( $M \pm m$ ), points

| Group | Stages of the experiment |            | Significance of the difference |      |        |
|-------|--------------------------|------------|--------------------------------|------|--------|
|       | Beginning                | End        | Difference                     | t    | p      |
| EG    | 42.32±0.76               | 36.18±0.57 | 6.14                           | 6.44 | <0.001 |
| CG    | 42.29±0.68               | 41.87±0.63 | 0.42                           | 0.45 | >0.05  |

Legend: M: arithmetic mean; m: error in standard deviation; t: t-test value, p: the significance of the difference between the indicators of studied groups before and after the experiment

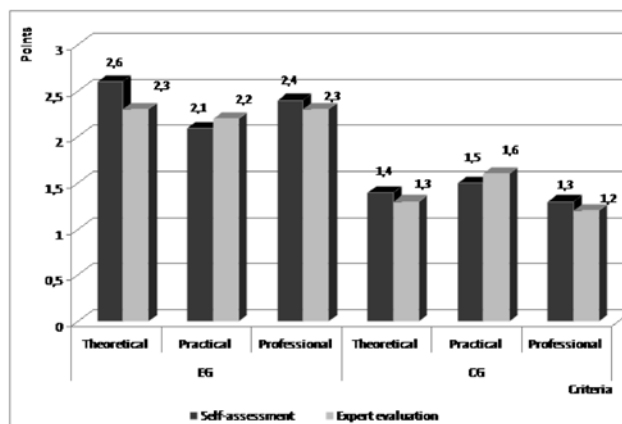
**Table 2.** Dynamics of the indicators of well-being in the EG and the CG students during the pedagogical experiment ( $M \pm m$ ), points

| Group | Stages of the experiment |           | Significance of the difference |      |        |
|-------|--------------------------|-----------|--------------------------------|------|--------|
|       | Beginning                | End       | Difference                     | t    | p      |
| EG    | 2.95±0.10                | 4.21±0.09 | 1.26                           | 9.37 | <0.001 |
| CG    | 3.07±0.11                | 3.36±0.11 | 0.29                           | 1.86 | >0.05  |

Legend: M: arithmetic mean; m: error in standard deviation; t: t-test value, p: the significance of the difference between the indicators of studied groups before and after the experiment

**Table 3.** Criteria and levels of students' self-regulation culture formedness

| Levels of formedness   |  |  |
|--|--|--|
| High   | Average  | Low  |
| Theoretical criterion  |  |  |
| Excellent knowledge of theoretical foundations of self-regulation.   | Knowledge of theoretical foundations of self-regulation is satisfactory.   | Fragmentary knowledge of theoretical foundations of self-regulation.   |
| Practical criterion  |  |  |
| Confident application of various methods and tools of self-regulation to stabilize one's own psychophysical state. Successful achievement of adaptation and health effects.  | Satisfactory application of individual methods and tools of self-regulation to stabilize one's own psychophysical state. Adaptation and health effects are not always achieved.      | Uncertain application of the simplest methods and tools of self-regulation to stabilize one's own psychophysical state. Adaptation and health effects are practically not achieved.                    |
| Professional criterion   |  |  |
| High ability to model possible stressful situations in future professional activities, quick orientation in choosing a set of various methods and tools of self-regulation, based on each specific situation, while showing a creative approach. | Average ability to model probable stressful situations in future professional activities, satisfactory orientation in the choice of individual methods and tools of self-regulation. | Low ability to model probable stressful situations in future professional activities, poor orientation in the choice of the simplest methods and tools of self-regulation, or complete disorientation. |



**Figure 1.** The level of self-regulation culture formedness in the EG and the CG students at the end of the pedagogical experiment, points

would be productive and of high quality. Their behavior is confident, mood is good, they are characterized by high efficiency and result orientation. The average level of self-regulation culture is observed in students whose emotions often prevail, and a person can not immediately master the situation in which he/she finds himself/herself. Students with this level sometimes enter into conflicts, although they know some ways to solve them and are mostly able to get out of difficult situations. Their behavior is mostly confident, they have good mood, satisfactory performance and are characterized by result orientation. A low level is a characteristic feature of hot-tempered and conflictual students who often get into difficult situations and cannot find a way out of them on their own. Such students do not know ways to resolve conflicts and do not have effective communication skills. Their behavior is uncertain, their mood is unstable, their performance is low and they have a low commitment to results.

The comparative analysis of the EG and the CG results shows qualitative changes in the level of self-regulation culture formedness in the EG students (both in terms of self-assessment and expert evaluation) for all the main criteria with a high degree of reliability ( $p < 0.001$ ) (Figure 1).

## DISCUSSION

According to the scientists [8, 9, 13], the psychological culture of the teacher is unthinkable without the culture of feelings, without the emotional and volitional sphere of his or her personality. The latter implies the ability to love, consciously control one's emotions, regulate one's actions and behavior, control oneself, create a positive emotional mood and a favorable psychological climate, understand the feelings of the high schooler, etc. Professionalism of a teacher is a set of psychophysiological, mental and personal changes that occur in a person in the process of mastering knowledge and long-term activities, which provide a qualitatively new, higher level of solving complex professional problems [6, 8]. In the study of various aspects of pedagogical and educational activities of future teachers, the phenomenon of self-regulation is considered as an important component of professional and pedagogical competence and as a significant factor in the success of educational and pedagogical activities [15]. Self-regulation of a personality is considered as the process of initiation, support and management of various types and forms of external and internal activities aimed at achieving the goals set by the subject; as the ability of a person to control himself or herself on the basis of the act of his or her behavior and his or her own mental reactions [11, 12].

The results of our experimental work revealed the effectiveness of the developed methodology of self-regulation culture formation in future teachers of humanities in the process of studying the author's specialized course referred to as "Fundamentals of Psychovaleology", which is confirmed

by qualitative positive changes in the emotional well-being of the EG students and a significant reduction in their level of situational anxiety.

The level of self-regulation culture formedness in the EG students, in contrast to the CG ones, has increased by all criteria: theoretical, practical and professional. Thus, according to the theoretical criterion, the increase in self-esteem of the EG students can be explained by the fact that the knowledge gained gave them more confidence in their preparedness for self-regulation. According to the criterion of practical formedness, which is characterized by the ability of students to apply a set of self-regulation methods to stabilize their own state, there were positive changes in students' behavior: they began to behave more confidently during the classes, actively, well controlled themselves in different situations modeled by the teacher, confidently used self-regulation tools. According to the criterion of professional formedness, which is characterized by the ability of students to model a variety of possible stressful situations in future professional activities, quickly navigating the choice of a set of self-regulation methods, based on each specific situation, while showing creativity, there were also positive changes compared to the CG. The results obtained complement and extend the findings of scientists in the field of mental and physical health [16-18].

## CONCLUSIONS

It was found out that the specialized course referred to as "Fundamentals of Psychovaleology", where the EG students learned methods of self-regulation, contributes to the formation and preservation of their mental health. In practice, this was manifested in the ability of students to creatively apply a set of methods and tools of self-regulation both in the learning process, where various unexpected situations were simulated, as close as possible to real life, and during pedagogical practice, where the general level of competence of individual health preservation was monitored, one of the integral characteristics of which is the capacity for self-regulation.

The developed and tested methodology of self-regulation culture formation in future teachers in the process of studying the academic discipline referred to as "Fundamentals of Psychovaleology" has proved its effectiveness and can become a significant basis for the further formation of individual health preservation competence of students i.e. future teachers, their orientation to active physical education as well as fitness and health recreation activities, and can also be included in the system of implementation of professional standards for the training of students in pedagogical specialties, especially in terms of the development of their health preservation competence.

*Prospects for further research. It is planned to investigate the relationship between the indicators of mental and physical health of students who have mastered the course referred to as "Fundamentals of Psychovaleology".*

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**ADDRESS FOR CORRESPONDENCE:**

**Gregory Griban**

Zhytomyr Ivan Franko State University, Zhytomyr, Ukraine  
e-mail: gribang@ukr.net

**ORCID ID and AUTHORS CONTRIBUTION**

0000-0002-9049-1485 – Gregory Griban (A, F)

0000-0002-9800-5525 – Serhii F. Kudin (A,D)

0000-0002-8092-542X – Hanna I. Zhara (B)

0000-0001-5938-8589 – Andrii V. Kuzhelnyi (B)

0000-0002-0609-6416 – Tamara V. Mazur (C)

0000-0003-1077-8206 – Yuliya M. Nosko (E)

0000-0001-9485-9139 – Olha B. Mekhed (D)

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



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# Substantiation of the Program of Recreational and Health-promoting Training Sessions with Instructors Officers During their Professional Activities

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Ivan M. Okhrimenko<sup>1</sup>, Nataliia O. Bilevych<sup>1</sup>, Olena V. Kryzhanovska<sup>2</sup>, Oksana M. Miroshnichenko<sup>3</sup>, Serhii M. Yermak<sup>3</sup>, Nataliya S. Razumeyko<sup>3</sup>, Nataliia Liakhova<sup>4</sup>

<sup>1</sup>National Academy of Internal Affairs, Kyiv, Ukraine

<sup>2</sup>Head Office of the National Police in Odesa region, Odesa, Ukraine

<sup>3</sup>Academy of the State Penitentiary Service, Chernihiv, Ukraine

<sup>4</sup>Poltava State Medical University, Poltava, Ukraine

## SUMMARY

**Aim:** The aim is to substantiate the program of recreational and health-promoting training sessions with instructor officers of higher educational institutions with specific learning environment of different ages during their professional activities.

**Materials and Methods:** The research was conducted in 2019-2022. Research methods: theoretical analysis and generalization of literary sources, pedagogical observation, programming, modeling. 140 instructor officers (men) of different age groups were involved in the research.

**Results:** On the basis of the analysis of literary sources, the study of the practical experience of instructional activities, we substantiated the authors' program of recreational and health-promoting training sessions with the instructor officers, the essence of which is to increase the amount of motor activity of the instructional staff through the use of simple and available means of general physical training, taking into account instructors' age, their state of health, the focus of the training sessions and the time of the training sessions during the day.

**Conclusions:** As a result of the implementation of the authors' program in the educational process, changes were made to the organization of physical training of the instructional staff, which provide for conducting training sessions according to a "flexible" schedule depending on the academic load of instructors; the ratio of the volumes of general and special physical training has been changed, which provides for an increase in the specific weight of general physical training; recreational and health-promoting training sessions have been introduced, depending on the time of the training session during the working day.

**Key words:** recreational and health-promoting training sessions, health, physical training, instructors

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## INTRODUCTION

The intellectual activities of instructor officers of higher educational institutions with specific learning environment (HEIs SLE), where law enforcement officers are trained, from the point of view of physiology, is characterized by significant brain stress due to the concentration of attention on a limited range of ideas or objects. In this regard, the excitation process in the central nervous system is concentrated in a relatively small area of nerve centers, which results in rapid fatigue [1, 2]. The impact of mental work on the body consists of the direct impact at the end of the working day (acute impact) and what accumulates over the years (chronic impact). This impact consists in reducing the impulse from the muscles to the central nervous system, which is associated with low motor activity. It results in the development of inhibitory processes in the cerebral cortex, a significant decrease in the tone of the muscles of the whole body, weakening of the functions of internal organs,

slowing down of metabolic processes [3, 4]. These adverse phenomena, caused mainly by a decrease in motor activity, can be eliminated by the use of physical exercises. Physical exercises create a new dominant in the central nervous system, which relieves tension from other areas of the brain. Such a redistribution of the processes of excitation and inhibition leads to an improvement in the performance of the brain after physical exercises and to body health promotion [5, 6].

The health-promoting effect of physical exercises is based on the close relationship between working muscles and the nervous system, metabolism and functioning of internal organs. Under the condition of regular exercise, the work of all organs and systems of the body is optimized: metabolism is improved, oxygen delivery to tissues and organs is enhanced, cholesterol content is reduced, decay products are more efficiently removed from the body, all systems are economized, as well as psychological reliefs facilitated [7].

However, the scientists [8, 9] claim that depending on the focus of physical exercises, workload and time of training sessions during the working day, the effect of their use can be of different nature: both positive and negative. Thus, in relation to instructional activities, the use of physical exercises in the process of mental work (between academic training sessions) should be aimed at restoring lost nervous energy, improving blood supply to the brain by performing simple exercises of moderate intensity i. e. training sessions should be recreational in nature. At the same time, it is necessary to avoid intensive muscle work, heavy loads and exercises that cause emotional excitement, since the latter can complicate further inclusion into mental activity and reduce its effectiveness.

At the same time, instructor officers, whose activities take place in conditions of intense intellectual work, hypodynamia, and under the influence of other unfavorable factors, need full-fledged physical training, which makes it possible to achieve such a state of the body, which ensures not only high physical performance, but also increases their functional capabilities and promotes health i.e. training sessions should be health-promoting and training in nature [1].

The scientists [10] claim that the specifics of the service activities of the instructor officers of HEIs SLE require physical exercises to be focused on the development of their general physical fitness i.e. promoting health, forming the foundation for improving the quality of the performance of instructor officers' service duties. The largest percentage of time in training sessions with instructor officers should be devoted to the development of their general endurance and strength qualities in order to increase the level of their health and improve mental working capacity.

### **AIM**

The aim is to substantiate the program of recreational and health-promoting training sessions with instructor officers of HEIs SLE of different ages during their professional activities.

### **MATERIALS AND METHODS**

The research was conducted in 2019-2022 at the National Academy of Internal Affairs (Ukraine). Research methods: theoretical analysis and generalization of literary sources (15 sources on the topic of the article from the scientometric databases PubMed, Scopus, Web of Science Core Collection and others were analyzed), pedagogical observation, programming, modeling. 140 instructor officers (men) of different age groups were involved in the research.

The procedure for organizing the study was previously agreed with the committee on compliance with Academic Integrity and Ethics of the NAIA. The topic of the study was approved by the Academic Council of the NAIA (No.3 dated 21.10.2019). Informed consent was received from all participants who took part in this study.

### **RESULTS**

On the basis of the analysis of literary sources, the study of the practical experience of instructional activities, we substantiated the authors' program of recreational and health-promoting

training sessions with the instructor officers. The peculiarities of the authors' program are the following: conducting training sessions with a predominant focus on the development of the general physical fitness of the instructional staff; increasing the specific weight of exercises for the development of endurance and strength qualities in the content of training sessions; conducting training sessions in the amount that corresponds to regulatory documents (4 hours per week); conducting physical education training sessions with a recreational and health-training focus depending on the time of the training session during the day; rational dosing of workload depending on the orientation of training sessions, the level of physical fitness, health and age of instructors; systematic conduct of training sessions during the week, with breaks of 2-3 days, will allow to ensure the involvement of a significant number of instructors in training sessions; simplicity and accessibility of exercises will ensure a high density of training sessions and a positive effect for instructors of different age groups; minimum material costs for organizing training sessions and the possibility of conducting training sessions in the gym hall and in the fresh air.

We defined the tasks of the authors' program: increasing the level of general physical fitness of the instructional staff with an emphasis on the development of endurance and strength qualities; promoting the health and improving the morpho-functional status of instructors; improving their mental capacity; preventing occupational diseases and extending professional longevity; increasing the body's resistance to adverse factors of professional activities; improving professionally important psychological qualities; involving the instructional staff in regular and systematic physical exercises.

The content of the authors' program consists of physical exercises, theoretical knowledge, methodological skills and abilities. The content is aimed at developing a complex of basic physical qualities, such as general endurance, strength of the main muscle groups (legs, back, shoulder girdle, abdomen), strength endurance, static endurance of the trunk muscles, flexibility, as well as health promotion, improvement of the functional status of the cardiorespiratory system, improvement of mental capacity, formation of resistance to negative factors of professional activities, enhancement of professionally important qualities (attention, memory, emotional state), formation of volitional qualities (purposefulness, perseverance, courage and determination). The following means of general physical training were used to perform the tasks of the authors' program: exercises for the development of endurance – 50%; exercises for the development of strength qualities – 40%; exercises for the development of flexibility, agility and other physical qualities – 10%.

Depending on the time of day, training sessions with instructional staff had different focus: recreational and health-promoting. Training sessions with a recreational focus are aimed at preserving and maintaining an optimal level of mental capacity, physical fitness, prevention of fatigue, as well as neuro-emotional relaxation after intensive mental work. Simple and accessible exercises were included in the content of training sessions with a recreational focus. Such

exercises include: exercises the aim of which is to engage in active, dynamic work those muscle groups that were in a static position (stretching exercises, turns and tilts of the body in different directions, squats, lifting legs, circular movements with hands), exercises for improvement of blood supply to the brain (movements, rotations of the head, neck, body), walking, medium and long distances slow running, exercises with the weight of one's own body and on gymnastic equipment (parallel bars, horizontal bar), pair exercises, exercises with a jumping rope, exercises for prevention of stagnation of blood circulation in the lower limbs (body bending, handstand) and others. Movement and sports games (at a moderate pace) were also used to relieve emotional stress and fatigue. Exercises were performed at the level of 30-50% of maximum capacity. Physical training sessions with a training focus more effectively affect the development and improvement of the basic physical qualities, functional capabilities of the body and promoting of the health of instructor officers, thereby contributing to the increase of their professional working capacity. Exercises that contribute to the effective improvement of the teachers' basic physical qualities are included in the content of training sessions with a health-promoting focus. Such exercises include: different distances cross country running, exercises for the muscles of the whole body, exercises with weights, exercises on simulators, exercises for strengthening the ligamentous-muscular apparatus of the spine and developing strength and static endurance, flexibility, agility, coordination and attention, sports games. On the basis of the above-mentioned exercises, combined movements were developed for instructor officers with different levels of physical condition and different age groups. Training sessions were mainly conducted in a complex circular method.

According to the authors' program, two one-hour training sessions with a recreational orientation and one two-hour health-promoting training sessions were planned in the weekly cycle. The planning and conducting of training sessions according to the authors' program was entrusted to the heads of the departments, depending on the educational load of each subordinate instructor (based on the schedule of academic instructional hours), and the direct control of the conduct of training sessions was carried out by instructors of the department of special physical training.

Training sessions with a recreational focus according to the developed program were held between the first and third or between the second and fourth double periods of academic instructional hours. Performing physical exercises between academic instructional hours was aimed at improving hemocirculation in the vessels of the brain of instructor officers, preventing blood stagnation in the lower extremities, and increasing mental capacity, preventing fatigue, removal of emotional and psychological tension, achieving emotional relaxation. Training sessions for health-promoting and training focus were planned after the academic instructional hours or at the end of the working day in such a way that the instructor was not involved in intense intellectual activities after the training session.

The amount of workload received by the instructor officers in the process of training sessions according to the authors' program depended on the focus of the training session, the time during the day, the age group and the level of fitness (physical condition) of the instructors. We developed optimal heart rate regimes for instructor officers of different age groups during different physical activities (during training sessions with different focus) (Table 1). The results presented in the table show that the maximum permissible heart rate of instructors under 30 years of age should not exceed 180-190 beats/min during training sessions, for instructors over 45 years of age – 140-150 beats/min. The heart rate for restorative loads (for recreational training sessions) should not exceed 140-150 beats/min for officers under 30 years of age, for instructors of older age groups – 110-120 beats/min.

In addition, the dosage of the load was determined by the nature of the exercises, the number of sets and repetitions in each set, the weight of the weights, the pace of the exercise, etc. Thus, the number of repetitions in each set depended on the degree of muscle tension, the level of fitness and the age characteristics of the instructors: the number of sets decreased for more prepared and young instructors and the number of repetitions increased (at the same time, the rest interval decreased and the pace increased); on the contrary, the number of sets increased and the number of repetitions decreased for officers with an insufficient level of physical condition, older age groups. Rest before the next set should ensure full recovery. The number of repetitions decreased

**Table 1.** The amount of the load (pulse modes) in terms of physical exercises with different focus for instructor officers of different age groups (beats/min)

| Age groups, years | Training sessions focus |         |         |          |                  |         |         |          |
|-------------------|-------------------------|---------|---------|----------|------------------|---------|---------|----------|
|                   | Recreational            |         |         |          | Health-promoting |         |         |          |
|                   | Amount of load          |         |         |          |                  |         |         |          |
|                   | low                     | average | high    | maximum  | low              | average | high    | maximum  |
| under 30          | under 110               | 110-120 | 120-140 | over 140 | under 130        | 130-150 | 150-180 | over 180 |
| under 35          | under 105               | 105-115 | 115-130 | over 130 | under 125        | 125-145 | 145-170 | over 170 |
| under 40          | under 100               | 100-110 | 110-120 | over 120 | under 120        | 120-140 | 140-160 | over 160 |
| under 45          | under 95                | 95-100  | 100-115 | over 115 | under 115        | 115-135 | 135-150 | over 150 |
| over 45           | under 90                | 90-100  | 100-110 | over 110 | under 110        | 110-125 | 125-140 | over 140 |

**Table 2.** The ratio of aerobic and anaerobic exercises for instructor officers of older age groups (40 years and older), %

| The level of physical condition | Exercises of aerobic focus | Exercises of anaerobic focus |
|---------------------------------|----------------------------|------------------------------|
| Low and below average           | 60-75                      | 25-40                        |
| Average                         | 50                         | 50                           |
| Above average and high          | 25-40                      | 60-75                        |

in complex exercises and exercises with a greater load, and it increased in simple exercises.

The ratio of aerobic and anaerobic exercises for instructor officers of older age groups (40 years and older) with different levels of physical condition is shown in Table 2.

## DISCUSSION

The analysis of literary sources of recent years [11] showed that in order to achieve the main objective of physical education, which is to achieve the optimal state of physical health of different strata of the population, scientists are inclined to develop individual health programs. However, in the course of substantiation and development of authors' programs, a number of important provisions should be taken into account, including: programming requirements; focus and content of physical exercises by persons of different ages and with different levels of physical condition; the effect of physical exercises on indicators of mental working capacity and the efficiency of professional activities, taking into account the time of training sessions during the day.

The problem of promoting the health and increasing the efficiency of the professional activities of the instructional staff of the HEIs SLE can be solved by using available means of general physical training, taking into account the age group and the time of the training session during the day (focus of training sessions). Along with the development of basic physical qualities, physical exercises should contribute to promoting health, increasing the body's resistance to negative factors of professional activities, developing and improving professionally important qualities and functional capabilities of the body, necessary for increasing mental working capacity in the academic process [2, 10].

The scientists [12, 13] note that it is necessary to rationally combine means of general physical training of different focus in order for physical exercises to give the best result, ensuring a high level of health and working capacity of law enforcement officers. Physical exercises of moderate intensity are an effective means of preventing depression and anxiety. Moderate-intensity work lasting at least 30 minutes improves all indicators of quality of life. Regular physical activity lasting 30-60 minutes a day promotes health and increases the efficiency of professional activities. It has been established that it is advisable to use a complex option i. e. the use of various simple and accessible exercises for all age groups in the program of physical exercises for instructor officers. This is due to the following provisions: it is possible to perform various exercises, change the load, rationally alternate load and rest for a long time; engaging in one physical exercise at the initial stages of training through the development of

individual physical qualities increases the general level of health and working capacity, and in the future it leads to a significant increase in the level of a certain physical quality, but a significant decrease in the reliability of other body systems; insufficient loading of some organs and systems of the body and excessive overloading of others, observed during unilateral training, results in atrophy or premature wear of the first (an example of this is the increased percentage of diseases of people who have been engaged in one sport for a long time); training sessions with different focus of the means involve a large number of muscles, which ensures versatile physical development of a person, improvement of all his organs and systems (a change in the focus of physical load is a specific stimulus to which the body responds with a complex of protective reactions).

The scientists [14, 15, 16] claim that it is very important to determine the ratio of means of training both in one training session and for longer periods of time. Irregular and unsystematic use of various means in the course of training sessions not only fails to contribute to the growth of working capacity, but can also negatively affect the state of health. In this case, the body perceives the load as a random factor and does not respond to it with adaptation processes. In the future, when the body adapts to the same type of load, the adaptation processes begin to weaken. The authors' program, substantiated and developed by us, is designed to ensure a high level of professional activities of instructor officers of HEIs SLE by promoting their health and improving working capacity.

## CONCLUSIONS

As a result of the implementation of the authors' program in the educational process of the HEIs SLE, changes were made to the organization of physical training of the instructional staff, which provide for conducting training sessions according to a "flexible" schedule depending on the academic load of instructors; the ratio of the volumes of general and special physical training has been changed, which provides for an increase in the specific weight of general physical training; recreational and health-promoting training sessions have been introduced, depending on the time of the training session during the working day; the level of attendance at physical training sessions by instructor officers has increased.

The implementation of the authors' program will improve the indicators of the general physical fitness of instructor officers, improve the indicators of their physical development, functional state, health, professionally important psychological qualities and mental working capacity, which will contribute to increasing the efficiency of the professional (academic)



activities of the instructional staff of the HEIs SLE. A high level of professional activities efficiency and good health of instructor officers will contribute to improving the training of future law enforcement officers.

*Prospects for further research. It is planned to evaluate the effectiveness of the authors' program to promote the health and functional state of instructor officers.*

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## Conflict of interest:

The Authors declare no conflict of interest

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## ADDRESS FOR CORRESPONDENCE:

**Ivan M. Okhrimenko**

National Academy of Internal Affairs, Kyiv, Ukraine

e-mail: ivango-07@ukr.net

## ORCID ID and AUTHORS CONTRIBUTION

0000-0002-8813-5107 – Ivan M. Okhrimenko (A)

0000-0002-1285-4527 – Nataliia O. Bilevych (B)

0000-0002-3423-6682 – Olena V. Kryzhanovska (D)

0000-0002-8624-9397 – Oksana M. Miroschnichenko (D)

0000-0002-5069-1001 – Serhii M. Yermak (C)

0000-0003-0801-3490 – Nataliya S. Razumeyko (E)

0000-0003-0503-9935 – Nataliia Liakhova (F)

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



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# 1st National Scientific Conference

## „COMPLEMENTARY DISCIPLINES OF PHYSIOTHERAPY” May 25-26, 2023

**Organizer: John Paul II University of Applied Sciences in Białą Podlaska  
– Department of Physiotherapy**

**Conference venue: John Paul II University of Applied Sciences in Białą Podlaska,  
St. Sidorska 95/97, hall 159R**

The aim of the conference is to present the trends and results of the latest scientific research in the field of complementary disciplines of physiotherapy, with an indication of their practical/application dimension in the context of strengthening professional competences of physiotherapists. We invite representatives of medical, social, natural, technical and other sciences who, through their activities, can participate in the process of comprehensive rehabilitation and strengthen patients' functional reserves.

### Conference topics:

- Psychotherapy
- Education
- Art therapy
- Occupational therapy and work therapy zootherapy
- Technical support for physiotherapy
- and others presenting new challenges in human and animal clinical medicine

### Workshops

The conference will include workshops on art therapy, animal therapy and new challenges in human and animal clinical physiotherapy.

Research and review papers will be presented in Polish in thematic sessions and a poster session.

The abstract prepared in Polish should contain from 150 to 250 words. In the case of research work, it should include: the purpose of the study, material and methods, results, conclusions and keywords. For reviews: description and keywords.

The submission\* along with the abstract should be sent by e-mail by April 15, 2023.

The Scientific Committee will select the papers for presentation at the Conference.

### Report card

\*The number of places is limited. We will inform you about the qualification by e-mail.

The conference fee in the amount of PLN 100 (only active participants – speech, poster) should be transferred by April 30, 2023, after acceptance of the application and the content of the speech (abstract).

It is planned to publish a reviewed post-conference monograph in 2023 at the ABNS Publishing House in Białą Podlaska.

The conference is co-financed from the state budget under the program of the Minister of Education and Science under the name „Excellent Science”, project number DNK/SP/549325/2022 - the amount of funding 49,225.00 PLN, the total value of the project 67,525.00 PLN.

All registered participants are provided with conference materials, the opportunity to participate in workshops, two lunches and coffee breaks; additionally for active participants (speech, poster): dinner on May 25, 2023, overnight stay on May 25/26, 2023, breakfast on May 26, 2023.

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Renata Rzeczkowska, MA

ABNS in Białą Podlaska

Department of Physiotherapy

21-500 Białą Podlaska, ul. Sidorska St. 95/97

phone: (083) 344 99 02

e-mail: r.rzeczkowska@akademiabialska.p