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- Analysis of Physical Therapy in Lumbosacral Discopathy
- The Evaluation of the Functional Exercise Capacity of Patients After Cardiac Surgeries
- Projecting of Health Programs for Post-COVID Patients at Fitness Centers
- Application of Systemic Cryotherapy in Cosmetology
- Magneto-LED Therapy in the Treatment of Venous Leg Ulcers - Case Report



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ANALYSIS OF PHYSICAL THERAPY IN LUMBOSACRAL DISCOPATHY

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ABSTRACT

Aim: To assess the efficacy of physical therapy in patients with lumbosacral discopathy.

Materials and Methods: The study included 31 individuals aged 24 to 67 years. A two-part survey questionnaire created by the authors was used as a research tool. The first part of the questionnaire was completed by the patient before the start of treatment and collected personal data as well as answers to questions concerning pain, physical activity and use of analgesic medication. Pain assessment was conducted using a visual analogue scale and the influence of pain on individual aspects of life was analysed using a specially modified Oswestry Disability Index. The second part was completed after treatment. The duration of physical therapy and rehabilitation was 15 days. Patients underwent electrotherapy procedures (interferential current therapy), local laser therapy, ultrasound therapy and kinesiotherapy.

Results: The study confirmed beneficial effects of the physical therapy and rehabilitation used in the patients on their quality of life. Pain elimination or reduction was reported, resulting in lower analgesic use. An analysis of the Oswestry Disability Index results obtained before and after treatment revealed an improvement with respect to physical function and quality of life. The objective condition of study patients also improved. Their ability with respect to walking, standing, sleeping, sitting, travelling, personal care and lifting was considerably increased.

Conclusions: Low back pain syndromes constitute a clinical and social problem. Treatment of this disorder is based on physical therapy and rehabilitation.

KEY WORDS: lumbosacral discopathy, physical therapy and rehabilitation, electrotherapy procedures

INTRODUCTION

Lumbosacral pain is an important problem of the 21st century in developed societies and causes considerable physical function limitations. It is a common cause of absence from work among people under 45 years of age (20% of sick leaves). Moreover, patients with lumbosacral pain become unable to work certain jobs. Lumbosacral pain is the second most common cause of absence from work and the third most common cause of surgical procedures in the United States. According to estimates, approximately 80% of people experience spinal pain at least once during their life. The onset of spinal pain is usually between the age of 25 and 65 years and its scope may vary [1-5].

The disorder has multiple causes, including lifestyle changes, reduced physical activity and spending a lot of time in a sitting position. As a result, the muscles that stabilise the spine become weaker, patients develop contractures of the iliopsoas muscles, postural abnormalities and static joint load, which has a negative influence on the biomechanics of the spine. The accumulation of overload and abnormal load leads to gradual and progressive microinjuries of the spine and paraspinal structures [6-10].

CLINICAL PRESENTATION

Pain is the first and most common symptom of the disorder and may take two different forms. Pain in patients in the

chronic phase or with herniation without annular tear may be dull, worsen gradually, intensify during movement and improve after rest or persist the whole time. Pain may be present in the low back only or radiate to the lower limb [10-14]. Patients may live with this type of pain for months or years and experience irregular periods of remission.

In cases with annulus fibrosus tear, the onset of pain is sudden and patients experience acute, shooting pain that often radiates to the lower limb. Patients also develop reflex muscle contractions that lock the trunk in a painless position. The type of radiating pain depends on the spine level at which herniation occurred. Pain caused by nerve root compression radiates according to the dermatomes supplied by the spinal nerves that have been irritated. Due to the pain, patients assume a posture that helps them unload the irritated nerve root and reduce nerve stretching. The centre of gravity is transferred forward and anterior pelvic tilt is observed, resulting from hip flexion. With unilateral pain, there is also knee and ankle joint flexion and reflex scoliosis appears [10-14].

Patients also show limited mobility of the lumbar spine in terms of trunk flexion and extension and lateral flexion towards the irritated nerve. Neurological disorders occur in the majority of patients and include tingling, numbness, burning or stinging. Abnormal temperature and touch sensation is also common.

In S1 nerve root irritation, sensory disturbances appear on the posterior surface of the shin, lateral surface of the foot and in the area of the fifth toe. Muscle weakening develops in the triceps surae and plantar flexors of the toes; consequently, the patient is unable to walk on their toes. Achilles tendon reflexes are reduced or absent.

L5 nerve root irritation causes sensory deficits on the lateral surface of the shin and in the area of the hallux. Muscle weakening develops in the foot and toe extensors, which leads to problems with walking on heels. Foot drop may also appear and the tibial reflex is reduced [10-14].

Gluteus muscle weakness on the affected side as well as thigh and shin muscle atrophy in the same limb are symptoms of L5 and S1 nerve root damage.

PHYSICAL THERAPY AND REHABILITATION

Treatment of low back pain syndromes is a long-term process that requires initiation of appropriate physical therapy and rehabilitation.

Lumbosacral discopathies require multidirectional physical therapy including physiotherapy, kinesiotherapy, massage and manual techniques [15-21]. The following methods are used: electrotherapy (interferential current therapy, diadynamic currents), ultrasound therapy, laser therapy, variable low-frequency magnetic field therapy, cryotherapy.

The main aims of kinesiotherapy and manual therapy used in low back discopathy include improving physical functioning, reducing dysfunction and facilitating recovery of the patient's condition. The most common therapeutic methods are trigger point therapy, core muscle strengthening exercises, post-isometric muscle relaxation, McKenzie exercises.

AIM

The aim of the study was to assess the efficacy of physical therapy used in patients with lumbosacral discopathy.

The authors aimed to answer the following research questions:

Will pain intensity (according to a visual analogue scale, or VAS) in study patients change after treatment compared to the pre-treatment values?

Will physical therapy eliminate the use of analgesic medication?

What significant differences will be seen in the objective condition of study patients measured before and after treatment?

Will physical therapy help improve physical function and quality of life?

MATERIALS AND METHODS

The study involved patients of the "Stommed" Health Care Centre in Radom who were referred to the Day Rehabilitation Unit for a three-week rehabilitation programme with the diagnosis of lumbosacral discopathy (usually L4-5, L5-S1). The study group consisted of 31 individuals, including 15 men (48.39%) and 16 women (51.61%). Study patients belonged to the following age groups: 45 years or younger (48.4%, 15 people), 46-56 years (12.9%, 4 people), 57-67 years (38.7%, 12 people).

A two-part survey questionnaire created by the authors was used in the study. The first part was completed by the patient before the start of treatment and collected personal data (age, sex, work status, type and nature of work, comorbidities) as well as answers to questions concerning pain, physical activity and use of analgesic medication. Pain assessment was conducted using a VAS and the influence of the disorder on individual aspects of life was analysed using a specially modified Oswestry Disability Index (ODI), which is a scale that allows for assessing disability due to lumbar pain. The ODI questionnaire included questions about pain intensity, lifting, walking, sitting, standing, sleeping, social life, sex life and travelling (the maximum score indicates considerable functional limitations). Patients selected a single answer in each question, choosing the option that best described their condition before treatment. The answers were scored from 1 to 3 and the scores were added up. The final score ranged from 1 to 30:

- 10-15 – minimal disability
- 16-25 – moderate disability
- 26-30 – severe disability

The duration of physical therapy was 15 days; the procedures were performed Monday to Friday for three weeks. Study patients underwent electrotherapy procedures (interferential current therapy), local laser therapy, ultrasound therapy and kinesiotherapy.

1. Interferential currents were applied to the lumbosacral spine with a frequency of 100 Hz (first 5 procedures), 80-100 Hz (procedure days 6-10), 0-100 Hz (procedure days 11-15).
2. Local laser therapy was used on both sides of the spine at the L1-S1 level, using a pulsed wave.
3. Ultrasound therapy was used along the spine on both sides of the spine at the L1-S1 level with the following parameters: 1 MHz, pulsed wave, 0.2 W/cm², duty cycle 20% (first 5 procedures), 40% (procedure days 6-10), 60% (procedure days 11-15).
4. Individual kinesiotherapy was adjusted to every patient and included isometric exercise, relaxation exercise, exercise with elements of the McKenzie method and post-isometric muscle relaxation.

After treatment, study patients completed the second part of the questionnaire, which asked about pain and analgesic medication use, and the ODI questionnaire, which assessed quality of life and physical function.

The data were statistically analysed, with calculations performed using the IBM SPSS software. Frequencies were calculated for qualitative variables and bar graphs were created. Means were calculated for quantitative variables and histograms were created.

The Kolmogorov-Smirnov test was used to check for the lack of consistency between the distribution of variables and the normal distribution. The significance level was set at $p < 0.05$.

Wilcoxon's test was used to assess the significance of differences for dependent samples. The significance level was set at $p < 0.05$.

Graphs were created in order to provide graphical representation of the statistically significant differences.

RESULTS

The distribution of study patients by their work status is presented in Table 1, including students, working and unemployed individuals and pensioners as well as people drawing a disability pension. Study patients were asked about the type of work they did. The answers included working in a standing and sitting position (Table 2). The nature of work reported by study patients was varied (Table 3). Another question asked study patients whether they were physically active or inactive, what kind of activity they preferred and whether they led a sedentary lifestyle. The distribution of answers by active and inactive patients is presented in the Table 4.

Another question asked study patients how often they engaged in physical activity. The answers are

Table 1. Distribution of study patients by work status

	N	Proportion
Student	1	3.22%
Working	22	70.97%
Pensioner/on disability pension	5	16.13%
Unemployed	3	9.68%
Total	31	100%

Table 2. Distribution of study patients by type of work

	N	Proportion
Standing	3	9.7%
Sitting	9	29%
Other	11	35.5%
Not applicable	8	25.8%
Total	31	100%

Table 3. Distribution of study patients by nature of work

	N	Proportion
Manual	13	42%
Intellectual	9	29%
Other	1	3.2%
Not applicable	8	25.8%
Total	31	100%

Table 4. Distribution of study patients by physical activity

	N	Proportion
Physically active	27	87.1%
Physically inactive	4	12.9%
Total	31	100%

Table 5. Distribution of study patients by frequency of physical activity

	N	Proportion
Irregular / occasional	10	32.3%
1-2 times a week	8	25.8%
3-4 times a week	7	22.5%
More often	3	9.7%
Not applicable	3	9.7%
Total	31	100%

presented in the Table 5. Study patients were asked about comorbidities in a multiple-choice question. The answers are presented in the Table 6. The questionnaire also asked study patients about how often they used analgesic medication (Table 7).

Apart from pain, patients often experience other symptoms, such as tingling, numbness or morning stiffness. A multiple-choice question asked study patients about their symptoms. The answers are presented in the Table 8. The majority of study patients already had a history of low back pain (Table 9). Study patients were also asked how long they had been experiencing low back pain (Table 10). Study patients were also asked about the frequency of undergoing rehabilitation (Table 11).

Study patients were again asked questions after they had completed their physical therapy and rehabilitation programme. The answers are presented in the Table 12. Study patients were asked about other symptoms after treatment (Table 13).

Table 6. Prevalence of comorbidities in study patients

	Answers	
	N	Proportion
Hypertension / ischaemic heart disease	11	50%
Diabetes	6	27.3%
Thyroid disease	5	22.7%
Total	22	100%

Table 7. Distribution of study patients by the frequency of using analgesic medication before treatment

	N	Proportion
No	10	32.26%
Yes, occasionally	17	54.84%
Yes, often	4	12.9%
Total	31	100%

Table 8. Proportion of study patients with other symptoms before treatment

	Answers	
	N	Proportion
Tingling	10	26.3%
Numbness	12	31.6%
Morning stiffness	14	36.8%
Other	2	5.3%
Total	38	100%

Table 9. Distribution of study patients by history of lumbosacral pain

	N	Proportion
Yes	23	74.19%
No	8	25.81%
Total	31	100%

Table 10. Distribution of study patients by duration of low back pain from the first episode

	N	Proportion
Up to 4 years	11	35.5%
5-9 years	11	35.5%
10 years and longer	3	9.6%
Not applicable	6	19.4%
Total	31	100%

Table 11. Distribution of study patients by frequency of rehabilitation

	N	Proportion
This is the first time	10	32.26%
Less than once a year	11	35.48%
1-2 times a year	8	25.81%
>3 times a year	2	6.45%
Total	31	100%

Table 12. Distribution of study patients by frequency of using analgesic medication after treatment

	N	Proportion
No	24	77.42%
Yes, occasionally	7	22.58%
Yes, often	0	0%
Total	31	100%

Table 13. Proportion of study patients with other symptoms after treatment

	Answers	
	N	Proportion
Tingling	7	41.2%
Numbness	4	23.5%
Morning stiffness	5	29.4%
Other	1	5.9%
Total	17	100%

An analysis using Wilcoxon’s test showed statistically significant differences in pain assessment before vs. after treatment ($p < 0.001$). This means that pain after treatment in study patients was less severe than before rehabilitation (Figures 1 and 2).

Wilcoxon’s test was utilised to check whether the amount of analgesic medication used by study patients after treatment was different than that recorded before treatment. Descriptive statistics for the amount of analgesic medication used by study patients are presented in the Table 14. Statistically significant differences were found in the proportion of patients using analgesic medication before vs. after treatment ($p < 0.001$). The proportion of those using analgesic medication was lower after treatment.

Wilcoxon’s test was used to check whether physical therapy and rehabilitation helped improve the physical function and quality of life in study patients. Figure 3 presents descriptive statistics for the ODI questionnaire before treatment. Figure 4 presents descriptive statistics for the ODI questionnaire after treatment. Statistically significant differences were found in the ODI questionnaire scores before vs. after treatment ($p < 0.001$), with the post-treatment scores being lower than those recorded before treatment. This means that the quality of life after treatment was

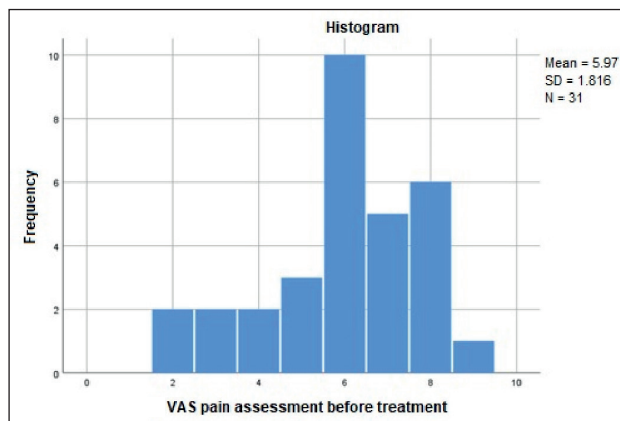


Figure 1. Descriptive statistics for pain intensity in study patients before treatment

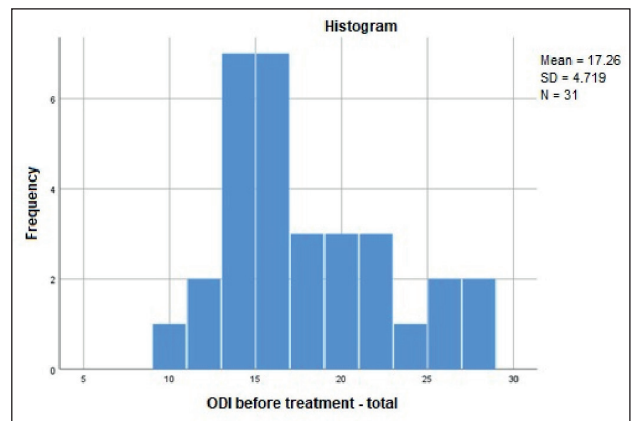


Figure 3. Descriptive statistics for the ODI questionnaire before treatment

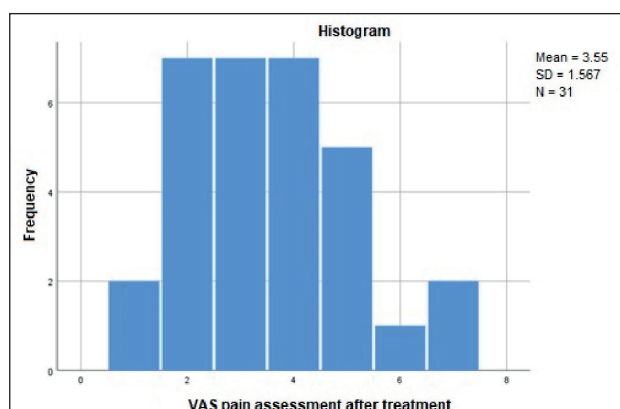


Figure 2. Descriptive statistics for pain intensity in study patients after treatment

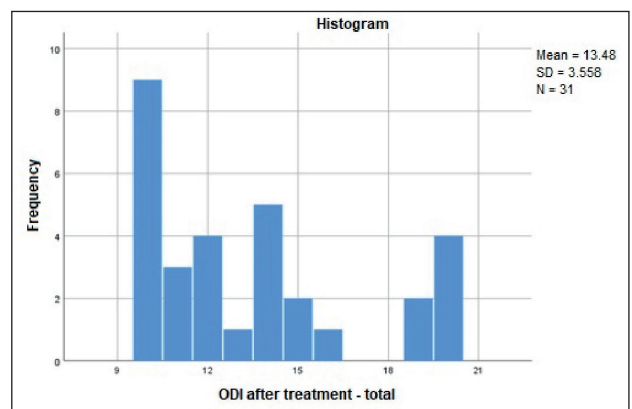


Figure 4. Descriptive statistics for the ODI questionnaire after treatment

higher and that there was a considerable improvement in the overall physical function of study patients.

The questionnaire asked study patients about activities that were difficult to perform and about the level of difficulty. Study patients answered the questions both before and after physical therapy and rehabilitation. Wilcoxon's test was used to check for significant differences in the objective condition of study patients before and after treatment. Calculations were performed for lifting, sitting during a period of time, sleeping, travelling, personal care, walking and standing.

Statistically significant differences were found with respect to lifting before vs. after treatment ($p < 0.001$), sitting before vs. after treatment ($p < 0.001$), sleeping before vs. after treatment ($p < 0.001$), travelling before vs. after treatment ($p < 0.001$), personal care before vs. after treatment ($p = 0.02$), walking before vs. after treatment ($p = 0.02$), standing before vs. after treatment ($p < 0.001$) (Tables 15-21).

DISCUSSION

The study showed a positive influence of physical therapy and rehabilitation on the quality of life in patients with lumbosacral discopathy. An analysis of the results obtained from a questionnaire completed before and after treatment revealed a considerable improvement in the objective and subjective condition of study patients. Pain after treatment was eliminated or considerably reduced. Three-fourths of study patients did not require analgesic medication after treatment.

An analysis of the ODI questionnaire with respect to the total score revealed that the quality of life and physical function were markedly higher after treatment. A considerable improvement was seen after physical therapy and rehabilitation in the activities described by study patients as difficult to perform. Study patients reported clear improvements with respect to activities of daily living such as personal care, sleeping, lifting, sitting, walking, standing or travelling. After treatment, the activities that had

Table 14. Descriptive statistics for the proportion of patients using analgesic medication before and after treatment

Value tested	N	Mean	Standard deviation	Min	Max	Wilcoxon's test	p
Did you take analgesics before treatment?	31	1.81	0.654	1	3	3.819	<0.001
Are you taking analgesics after treatment?	31	1.23	0.425	1	2		

Table 15. Descriptive statistics for lifting before and after treatment

Value tested	N	Mean	Standard deviation	Min	Max	Wilcoxon's test	p
Lifting before treatment	31	1.71	0.739	1	3	3.606	<0.001
Lifting after treatment	31	1.29	0.461	1	2		

Table 16. Descriptive statistics for sitting before and after treatment

Value tested	N	Mean	Standard deviation	Min	Max	Wilcoxon's test	p
Sitting before treatment	31	1.77	0.617	1	3	3.464	0.001
Sitting after treatment	31	1.39	0.495	1	2		

Table 17. Descriptive statistics for sleeping before and after treatment

Value tested	N	Mean	Standard deviation	Min	Max	Wilcoxon's test	p
Sleeping before treatment	31	1.84	0.688	1	3	3.500	<0.001
Sleeping after treatment	31	1.39	0.558	1	3		

Table 18. Descriptive statistics for travelling before and after treatment

Value tested	N	Mean	Standard deviation	Min	Max	Wilcoxon's test	p
Travelling before treatment	31	2.03	0.605	1	3	4.000	<0.001
Travelling after treatment	31	1.52	0.508	1	2		

Table 19. Descriptive statistics for personal care before and after treatment

Value tested	N	Mean	Standard deviation	Min	Max	Wilcoxon's test	p
Personal care before treatment	31	1.52	0.508	1	2	2.333	0.020
Personal care after treatment	31	1.29	0.461	1	2		

Table 20. Descriptive statistics for walking before and after treatment

Value tested	N	Mean	Standard deviation	Min	Max	Wilcoxon's test	p
Walking before treatment	31	1.45	0.675	1	3	2.333	0.020
Walking after treatment	31	1.23	0.425	1	2		

Table 21. Descriptive statistics for standing before and after treatment

Value tested	N	Mean	Standard deviation	Min	Max	Wilcoxon's test	p
Standing before treatment	31	1.87	0.562	1	3	3.873	<0.001
Standing after treatment	31	1.39	0.495	1	2		

previously been impossible for study patients to perform and had been associated with significant lumbosacral pain were now within the range of their capabilities. This resulted in an improvement in everyday comfort at work, at home and during social gatherings.

Study patients belonged to different age groups and did different types of work; some of them were physically active and some had comorbidities. However, pain caused by lumbosacral discopathy resulted in considerable limitations in everyday life and at work in all patients. The therapy used in study patients resulted in tremendous improvements in their condition.

Treatment of patients with this disorder is based on physical therapy and rehabilitation.

CONCLUSIONS

Lumbosacral pain syndromes constitute an important social and clinical problem.

The pain experienced by patients considerably limits their functioning.

The physical therapy and rehabilitation used in study patients effectively improved their physical function and quality of life.

After treatment, study patients reported pain elimination or a considerable pain reduction, which in turn resulted in a reduced use of analgesic medication.

Prevention at work and during activities of daily living as well as maintaining an appropriate posture and engaging in physical activity all play an important role in this disorder.

References

1. Kułak W, Kondzior D. Dyskopatia kręgosłupa odcinka lędźwiowo-krzyżowego w korelacji z natężeniem bólu, depresją i akceptacją choroby. [Discopathy of the lumbar spine in relation to intensity of pain, depression and illness acceptance]. *Probl Hig Epidem.* 2010;91(1):153-157. (in Polish).
2. Beazell JR, Mullins M, Grindstaff TL. Lumbar instability: an evolving and challenging concept. *J Manual Manipul Ther.* 2010;18(1):9-14.
3. Schaefer A, Hall T, Biffa K. Classification of low back-related leg pain. A proposed patho-mechanism-based approach. *Manual Ther.* 2009;14:222-230.
4. Kobayashi S, Baba H, Uchida K et al. Effect of mechanical compression on the lumbar nerve root: localization and changes of intradiscal inflammatory cytokines, nitric oxide, and cyclooxygenase. *Spine.* 2005;30:1699-1705.
5. Stafford MA, Peng P, Hill DA. Sciatica: a review of history, epidemiology, pathogenesis and the role of epidural steroid injection in management. *Brit J Anaesth.* 2007;99(4):461-473.
6. Takahashi H, Suguro T, Okazima Y et al. Inflammatory cytokines in the herniated disc of the lumbar spine. *Spine.* 1996;21:218-224.
7. Genevay S, Stingelin S, Gabay C. Efficacy of etanercept in the treatment of acute, severe sciatica: a pilot study. *Ann Rheum Dis.* 2004;63(9):1120-1126.
8. Takamoto K, Sakai S, Hori S et al. Compression on trigger points in the leg muscle increases parasympathetic nervous activity based on heart rate variability. *J Physiol Sci.* 2009; 59:191-196.
9. Kuliński W. Zespoły bólowe kręgosłupa – problemy diagnostyczne i terapeutyczne w praktyce lekarza rodzinnego. *Probl Med Rodz.* 2009;12(2):29-32. (in Polish).
10. Mostofi K. Total disc arthroplasty for treating lumbar degenerative disc disease. *Asian Spine J.* 2015;9(1):59-64.
11. Habibi Z, Maleki F, Meybodi AT et al. Lumbosacral sagittal alignment in association to intervertebral disc diseases. *Asian Spine J.* 2014;8(6):813-9.
12. Zagra A, Minoia L, Archetti M et al. Prospective study of a new dynamic stabilization system in the treatment of degenerative discopathy and instability of the lumbar spine. *Eur Spine J.* 2012;5(1):83-89.
13. Munoz F, Salmochi JF, Faouen P, Rougier P. Low back pain suffers: is standing postural balance facilitated by a lordotic lumbar brace. *Orthop Traumatol Surg Res.* 2010;96(4):362-6.
14. Chałusz M, Gasztych J, Irzmański R i wsp. Analiza skuteczności przeciwbólowej wybranych metod fizykoterapii u osób z zespołami bólowymi części lędźwiowo-krzyżowej kręgosłupa. [Comparative Analysis of Analgesic Efficacy of Selected Physiotherapy Methods in Low Back Pain Patients]. *Ortop Traumatol Rehab.* 2010;3(6); Vol. 12: 226-227.
15. Widłak P, Łukasiak A, Podkański I i wsp. Zastosowanie wyciągów lędźwiowych w leczeniu pacjentów z przewlekłymi zespołami bólowymi kręgosłupa – doniesienia wstępne. Lumbar traction in the treatment of patients with chronic spinal pain syndromes – a preliminary report. *Kwart Ortop.* 2012;3:373-374. (in Polish).
16. Borzęcki P, Wójtowicz-Chomicz K, Skowronek A i wsp. Rehabilitacja chorych z dyskopatią odcinka lędźwiowego kręgosłupa. [Rehabilitation procedures in patients with recognized lumbar discopathy]. *Fam Med Primary Care Rev.* 2012;3:346-347. (in Polish).
17. Gworys K, Rosiakowska J, Adamczewski T i wsp. Analiza skuteczności przeciwbólowej różnych metod fizjoterapii stosowanych w przewlekłym zespole bólowym kręgosłupa lędźwiowo-krzyżowego. [Analysis of analgesic efficacy of various physiotherapy methods in chronic lumbosacral spine pain syndrome]. *Kwart Ortop.* 2012;4:512-514. (in Polish).
18. Boyraz I, Yildiz A, Koc B, Sarman H. Comparison of high-intensity laser therapy and ultrasound treatment in the patients with lumbar discopathy. *Biomed Res Int.* 2015;25:304-328.
19. Olczak A, Kuliński W. Ocena zastosowania metod: McKenzie i PNF w dyskopatii lędźwiowej. [Evaluation of the McKenzie and PNF methods in lumbar disc herniation]. *Acta Balneol.* 2010;3(121):176-178. (in Polish).
20. Haładyna W, Marciniśzyn E, Kuliński W. Dyskopatie kręgosłupa – aktualny problem diagnostyczny i terapeutyczny. [Discopathies of the spine – a current diagnostic and therapeutic problem]. *Acta Balneol.* 2011;2:133-137. (in Polish).
21. Garczyński W, Lubkowska A. Physiotherapy in osteoarthritis of the lumbar spine. *J Health Scien.* 2013;3(4):118-130.

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CONFLICT OF INTEREST

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STUDY OF INDICATORS OF HEART RATE VARIABILITY OF ACROBATS AT THE STAGES OF LONG-TERM TRAINING IN THE ASPECT OF SEXUAL DIMORPHISM

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ABSTRACT

Aim: Study and comparative characteristics based on the data of heart rate variability (HRV) analysis of athletes specializing in pair-group acrobatics, taking into account age, features of sexual dimorphism at various stages of multi-year training

Materials and Methods: Acrobats of both sexes, of different sports qualifications, of the following stages of long-term training took part in the study: 1) group of training 9-11 years old: girls (n=38), boys (n=38); 2) sports improvement groups aged 12-15: girls (n=36), boys (n=36); 3) groups of higher sports skills aged 16-23: girls (n=32), boys (n=32).

Results: A gender comparison was made between groups of acrobats aged 9-11 years, but no statistically significant differences between girls and boys were found ($p > 0.05$). Comparative characteristics of boys 12-15 and 16-20 years old shows a statistical difference ($p > 0.5$).

Conclusions: In each of the age and gender groups, at different stages of multi-year improvement, acrobats with a different type of regulation – central or autonomous – were identified. The correlation analysis of the 12-15-year-old age group allowed us to obtain the following results: a high and medium degree of correlation between LF and TP indicators in both girls and boys ($r = 0.82$ and $r = 0.66$, respectively). A relationship between VLF and TP indicators was also revealed, in girls $r = 0.78$ and in boys $r = 0.72$.

KEY WORDS: heart rate variability, acrobats, physical activity, sexual dimorphism, long-term training

INTRODUCTION

Over the past decades, a significant number of both review and experimental articles have been published on the topic of heart rate variability (HRV) research, including in sports. This confirms the significance and relevance, among scientists, of the use of HRV indicators in studies of athletes under loads of different orientations [1-4]. Thanks to this method, scientists have the opportunity to obtain new and important information every time regarding the purpose and tasks of new research, especially in the case of physical exertion in athletes [5-8].

With regular physical education and sports, functional and structural changes in the central and peripheral mechanisms of the cardiovascular system are observed [9-13]. A significant number of scientists experimentally proved the inextricable connection between high sports results and the effectiveness of the training process of athletes, but the most important requirement is the correspondence of training loads to the athlete's functional state. It is well known that there are physiological indicators that reflect the tone of the athlete's sympathetic and parasympathetic nervous system (vegetative regulation of cardiac activity) [14-17].

As indicated by a number of authors, there are significant physiological and physical differences between athletes of various sports and narrow specializations [18, 19]. Depending on such individual indicators as special endurance, strength, flexibility, as well as the specifics of the training load depending on the type of sport and recovery processes, there is also a type of optimal training depending on the correspondence to the specific abilities of athletes [20-22]. Therefore, the analysis of HRV in athletes of various sports reflects the main regulatory processes after specific physical exercises and stress [23-25].

So Mitskan B.M., Ostapyak Z.M. and co-authors analyzed the physiological basis and evaluation of the effectiveness of the use of heart rate variability indicators in athletes [26]. Data on HRV changes in female athletes in the dynamics of the menstrual cycle of female athletes were also highlighted [27]. Scientific studies are presented with a comparative characteristic of HRV indicators between subjects who exercise little and athletes of various sports, with the provision of different HRV profiles for improving physical and physiological conditions.

Also experts L.G. Korobeynikov and co-authors additionally suggest using orthostatic load to determine the degree

of tension of the body's regulatory systems in athletes with an optimal reaction [28]. A number of scientists began to actively study HRV indicators in the diagnosis of overtraining and fatigue in order to obtain additional data and develop methodological bases for increasing the physical performance of athletes. Due to training loads using HRV as a control, a greater number of athletes improved their psychophysiological indicators [29, 30].

In the theory and methodology of sports training, a significant number of works are devoted to the problem of sexual dimorphism, which is the basis of the gender difference in men's and women's sports [31, 32]. But there are still quite a few developments in the direction of pair-group acrobatics regarding the functional features of athletes' bodies. The above-mentioned analysis of the scientific and methodical literature prompted us to a wider study of HRV research indicators on the example of acrobats. In the literature available to us over the past 15 years, according to the materials of the Internet and bibliographic databases (Google Scholar, PubMed, Index Copernicus), we did not find any publications related to the study of HRV indicators in pair-group acrobatic athletes of different ages, qualifications, in different periods years of training taking into account sexual dimorphism, which became the goal of our research.

Sports acrobatics, as one of the sports in which Ukrainian athletes are among the best on the European and world arena, needs new scientific research.

In scientific research on various sports, especially in the structure of long-term training, HRV change indicators show their variability and, as indicated by a number of authors, do not always correspond to generally accepted algorithms [33-36].

Therefore, in our opinion, the use of the HRV method as an integral indicator of the functional state of the cardiovascular system in pair-group acrobatics is relevant and important in the theory and methodology of physical education and sports. It is advisable to use it in research to supplement already existing data and expand the results of HRV diagnostics in athletes, taking into account the characteristics of sexual dimorphism and the age of acrobats.

AIM

The aim of this study was a study and comparative characteristics of typical values of heart rate variability (HRV) indicators of athletes specializing in pair-group acrobatics, taking into account age, features of sexual dimorphism at various stages of multi-year training for the development of differentiated training programs.

MATERIALS AND METHODS

PARTICIPANTS

Acrobats of both sexes from children's and youth sports schools of the Dnipropetrovsk region, athletes from the reserve of the national team of Ukraine in sports acrobatics took part in the experiment: 1. Educational and training group 9-11 years old (average age 10.44 years for girls and 10.96 – for boys): girls (n=32), boys (n=34). 2. Group of sports improvement

12-15 years old (average age 13.84 years for girls and 14.04 years for boys): girls (n=30), boys (n=32). 3. Group of higher sports skills 16-23 years old (average age 19.12 years for girls and 19.88 years for boys): girls (n=36), boys (n=36).

Each experiment participant had 2 repeated recordings no earlier than 2 hours after training loads. In girls, in the presence of menstrual function, research was conducted on days that did not coincide with the first (menstrual) phase of the cycle. Informed consent was obtained from all participants to participate in this experiment. In the case of children aged 9-17, written consent was obtained from their parents.

The procedures were carried out in accordance with the ethical standards of the Helsinki Declaration of 2008.

METHODS

System-functional analysis of special literature and Internet resources. Pedagogical observation. Pedagogical experiment. Methods of mathematical statistics.

The variability of the heart rate of acrobats (VHR) was studied using the software and hardware complex «Cardio+» according to the following indicators and indices: Mo (mode – the value of the RR interval), AMo (amplitude of the mode – the percentage of cardio intervals RR corresponding to the value of the mode); VR (variation range – the difference between the duration of the largest and smallest RR-interval) and indices calculated on their basis to assess the processes of regulation and the degree of adaptation of the cardiovascular system to aggressive factors: IAB – index of autonomic balance ($IAB = AMo / VR$); R-R – the average duration of the intervals and the reciprocal of this indicator is the average heart rate; IARP – indicator of adequacy of regulation processes ($IARP = AMo / Mo$); VRI – vegetative rhythm indicator ($VRI = 1 / Mo \times VR$); IT – index of tension of regulatory systems ($IT = AMo / 2 \times VR \times Mo$), stress index (SI).

According to spectral estimates, the following indicators were calculated: TP, HF, LF, VLF and ULF power spectrum: Very Low Frequency (VLF) – ultra-low (from 0.003 to 0.04 Hz), Low Frequency (LF) – low (from 0.04 to 0.15 Hz) and High Frequency (HF) – high (from 0.2 to 0.4 Hz) frequency [37, 38].

PROCEDURE

The research was conducted in the control-preparatory and competitive periods on the basis of the Dnipropetrovsk State Medical University by a diagnostician, using the automated diagnostic complex «Cardio+» (manufactured by Ukraine).

Statistical analysis was performed using the STATISTICA 10.0 computer program and MS Excel XP application packages. A standard set of methods was used: arithmetic mean (M), mean square deviation (SD), standard error of the arithmetic mean (m).

Correlation analysis was used to analyze the relationship between the studied parameters, which allows to determine the degree of relationship between two variables. The Brave-Pearson correlation coefficient (r) determines the degree of linear relationship between variables.

The statistical Mann-Whitney U-test was used to assess the differences between two independent samples.

RESULTS

In young athletes of the group with a moderate advantage of central regulation, the spread of the main indicators of HRV in the age group of 9-11 years was (M±SD): R-R – from 558 to 748 ms (665.82±32.65), SI – from 102.0 to 334 conventional units (224.62±38.26), TR – from 1012 to 2980 ms² (1998.84±224.56), HF – from 202 to 715 ms² (468.86±120.53), LF – from 422 to 1043 ms² (634.24±125.48), VLF – from 306 to 488 ms² (374.16±28.92), ULF – from 195 to 490 ms² (295.62±86.72).

In the group of acrobats of this age group, the indicators of girls and boys were compared. In the group of young athletes with a vivid dominance of central regulation, no statistically significant differences were found between girls and boys (P>0.05).

In groups with a vivid predominance of central regulation (age 9-11 years) and with a moderate predominance of autonomic regulation, we found a tendency to increase HR, SI, HF, LF, and decrease RR, TP, VLF, ULF values. It should be noted that in the slow-wave structure of the spectrum, vasomotor waves prevail over respiratory waves (LF over HF, respectively).

Among the age group of young acrobats 12-15 years old (groups of sports improvement), three groups of athletes were identified during the study of HRV: 1 – with a moderate advantage of central regulation: boys 38%, girls 40%; 2 – with a vivid predominance of central regulation: boys 14%, girls 10%; 3 – with a moderate predominance of autonomous regulation: boys 48%, girls 50%.

We draw attention to the fact that the research was conducted in girls on days that did not coincide with the menstrual phase. It is known that during this period, hormonal changes occur in the female body, which can affect the results obtained. The results of HRV of acrobats of this age group are presented in the Table 1 taking into account the type of regulation.

In the group of acrobats with a vivid predominance of central regulation, which included girls (n=6) and boys (n=4), the following data were obtained (M±SD): R-R, ms (girls 717.56±55.83 boys 735.98±28.49 (reliability of differences at p<0.05; TP, ms² (1192.94±102.38 in girls and 1037.94±120.83 in boys, reliability of differences at p<0.05), LF (384.26±70.68 in girls and 372.59±54.06 in boys), VLF (152.52±35.24 and 152.08±17.38 girls and boys, respectively), ULF, ms² (165.64 ±34.11 in girls and 155.73±21.28 in boys).

The conducted correlation analysis of this age group made it possible to obtain the following results, namely: a high and medium degree of correlation between LF and TP indicators in both girls and boys (r=0.82 and r=0.66, respectively). A relationship between VLF and TP indicators was also revealed, in girls r=0.78 and in boys r=0.72.

Between R-Rmax and HF indicators, an average degree of relationship was found in boys (r=0.62), and a high one in girls (r = 0.88). R-Rmax and LF, medium and high correlations: in girls (r = 0.62), in boys (r=0.84).

The obtained data and the analysis of the gender comparative characteristics between the group of female

Table 1. Separate indicators of HRV of acrobats of both sexes with a moderate predominance of central and autonomous regulation (M±SD)

Gender	R-R, ms	TP, ms ²	LF, ms ²	VLF, ms ²	ULF, ms ²
Athletes with a moderate predominance of central regulation					
Girls (n=14)	705,45±25,26	1928,84±220,42	606,12±27,46	342,68±31,24	367,65±43,45
Boys (n=13)	717,04±31,63	1868,48±236,84*	665,74±94,18*	395,16±52,42*	280,38±32,76*
Athletes with a moderate predominance of autonomic regulation					
Girls (n=18)	822,74±25,22	4012,72±324,34	1132,73± 65,38	531,86±64,58	556,04±98,73
Boys (n=17)	881,96±37,45*	3996,68±376,08	1109,82± 101,56	485,18±61,46*	632,40±98,83*

Note: * – reliability of differences between the indicators of girls and boys p<0.05

Table 2. Average values of parameters of spectral analysis of heart rhythm of highly qualified acrobats (M±SD), taking into account gender dimorphism (control-preparatory stage)

Indicators	Reaction type of heart rhythm regulation					
	Optimal (I)		Moderate loading (II)		Overloading (III)	
	girls	boys	girls	boys	girls	boys
VLF, ms ²	18,02±4,22	22,32±8,34	12,76±4,74*	16,74±4,34**	11,35± 3,35	9,5± 3,02
*p<0,05 among the girls of I and II groups ** p<0,001 among the boys of I and II groups						
LF, ms ²	38,34± 7,38	35,76±9,85	26,48±5,84	22,98±5,17	10,54± 3,89	12,47±3,85
HF, ms ²	36,83± 5,38	33,47±6,76	10,02±4,84*	11,65±3,88**	5,35± 1,98*	4,05± 1,09**
*p<0,001 among the girls of I and II groups, II and III ** p<0,001 among the boys of I and II groups, II and III						
LF/HF	0,92± 0,36	1,03± 0,44**	1,53± 0,56	2,04± 0,88	4,15± 1,67*	5,34± 1,98**
*p<0,001 among the girls of I and III groups ** p<0,001 among the boys I and III groups						

acrobats and male acrobats aged 12-15 were statistically highly significant ($p < 0.05$) for a number of indicators, namely, in male acrobats, a gradual decrease in the vegetative effects on the heart rhythm and increasing the voltage of regulatory systems.

In the girls of the sports improvement group (12-15 years), when compared with the group of higher sports skills (16-22 years), the vegetative effects on the heart rhythm and the degree of stress of the regulatory systems remained without significant statistically important changes ($p > 0.5$).

Table 2 shows the spectral analysis data of highly qualified acrobats of both sexes.

Correlation analysis, which was carried out among the investigated HRV indicators of the age group 16-23 years, showed the following results: a high and medium degree of correlation between LF and TP indicators in girls ($r = 0.7$), in boys ($r = 0.68$), a strong correlation relationship $r = 0.88$ was found between VLF and TP indicators in girls and $r = 0.76$ in boys.

A comparative analysis of HRV between acrobats aged 12-15 and 16-23 years showed that a number of indicators were statistically highly significant ($p < 0.05$), in young men a gradual decrease in vegetative influences on the heart rhythm and an increase in the tension of regulatory systems at the age of 16-23 were revealed. Among girls, during the transition from the groups of sports improvement (13-15 years) to the group of higher sports skills (16-22 years), the vegetative effects on the heart rhythm and the measure of tension of the regulatory systems remained without significant statistically important changes ($p > 0.5$).

Correlation analysis of the age group of 12-15 years allowed to obtain the following results, namely: a high and medium degree of correlation between LF and TP indicators in both girls and boys ($r = 0.82$ and $r = 0.66$, respectively). A relationship between VLF and TP indicators was also revealed, in girls $r = 0.78$ and in boys $r = 0.72$.

Between R-Rmax and HF indicators, an average degree of relationship was found in boys ($r = 0.62$), and a high one in girls ($r = -0.88$). R-Rmax and LF, medium and high correlations: in girls ($r = -0.62$), in boys ($r = 0.84$).

DISCUSSION

It is well known that regular physical activity and many years of sports contribute to functional and structural changes in the central and peripheral mechanisms of the cardiovascular system [39, 40].

European experts developed standards for the use of HRV indicators in clinical practice, based on which scientists conduct a significant amount of research [41]. The HRV method is highly sensitive, so we relied on strict adherence to the necessary methodological recommendations regarding HRV in acrobats.

In our research among young acrobats 9-11 years old, three groups of athletes were identified when studying HRV: 1st group – with a moderate advantage of central regulation: boys 40%, girls 42%; 2nd group – with a vivid predominance of central regulation: boys 10%, girls 12%; 3rd group – with a moderate predominance of autonomous regulation: boys 50%, girls 48%.

The obtained results of HRV indicators and the wave structure of the spectrum in the target age group of 9-11 years showed a changeable nature. When studying gender differences in HRV indicators, it was found that girls in the age range of 9-11 years have heart rate (bpm) higher than boys, on average, by 11.08%, less than R-R, but greater total power spectrum (TP) and its components HF, VLF and ULF.

The analysis of the indicators of individual athletes aged 12-15 years at the beginning and at the end of the control-preparatory mesocycle shows that certain HRV parameters indicate a sharp activation of autonomic regulation. This indicates the fact that the greater the sports experience and qualification of athletes, the more vivid it is reflected in HRV indicators.

The comparative characteristics of the analysis of HRV indicators of 9-11-year-old and 12-15-year-old acrobats confirms and expands the research of the authors that during puberty period a tendency to increase the tension of regulatory systems was revealed, regardless of which type of heart regulation the athletes belong to.

The analysis of HRV immediately after the loading and during the orthostatic test showed characteristic reactions, the data of which can be used in the planning and dosing of loads and the assessment of the compliance of these loads with the level of fitness and gender of the acrobats.

In the group of acrobats with a vivid predominance of autonomous heart rate regulation while gender analysis of HRV it was revealed that boys have a lower total amplitude of respiratory waves (HF) and more vasomotor waves (LF). Both boys and girls are characterized by fluctuating processes of maturation of regulatory systems.

For acrobats with a vivid predominance of central regulation, in our opinion, individual correction in planning training loading is necessary, since the obtained data indicate a vivid state of fatigue of young athletes.

CONCLUSIONS

In the studies, the typical values of HRV indicators of athletes specializing in pair-group acrobatics were determined, taking into account age, qualifications, features of sexual dimorphism at different stages.

1. Comparative characteristics of the group of sports improvement with the group of higher sports skills (16-23 years old), in young acrobats, a decrease in the activity of the parasympathetic link of the autonomic nervous system, as well as a statistically significant ($p < 0.05$) decrease in the autonomic effects on the heart rhythm were found.

2. The conducted correlation analysis of the age group of 9-11 years allowed to obtain the following results, namely: a high and medium degree of correlation of LF and TP indicators in both girls and boys ($r = 0.82$ and $r = 0.66$ in accordance). A relationship between VLF and TP indicators was also revealed, in girls $r = 0.78$ and in boys $r = 0.72$.

3. The obtained data and analysis of gender comparative characteristics between the group of female acrobats and male acrobats aged 13-15 according to a number of indicators were statistically highly significant ($p < 0.05$), namely, in male acrobats, a gradual decrease in vegetative influences

on rhythm was revealed of the heart and increasing the tension of the regulatory systems. In girls, the comparative characteristics of the acrobats of the sports improvement groups (13-15 years) with the group of higher sportsmanship (16-22 years), the vegetative effects on the heart rhythm,

and the measure of tension of the regulatory systems do not have significant statistically significant changes ($p > 0.5$).

Prospects for further research are planned in the direction of conducting research on HRV indicators of acrobats taking into account the menstrual cycle.

References

- Mickan BM, Ostapyak ZM, Mickan TS et al. Variabelnist sercevego ritmu sportsmeniv. [Variability of heart rate of athletes. Rehabilitation and physical culture and recreational aspects of human development] Reabilitacijni ta fizkulturno-rekreacijni aspekti rozvitku lyudini. 2022; 12(18): 128-143. (in Ukrainian).
- Podrigalo LV, Volodchenko OA, Sokol KM, Rovna OO. Doslidzhennya variabelnosti sercevego ritmu atletiv kikkboksingu. [Study of heart rate variability of kickboxing athletes] Visnik Chernigivskogo universitetu. Seriya: Pedagogichni nauki. Fizichne viovannya ta sport. 2017; 147 (2): 240-244 (in Ukrainian).
- Shevchuk TI, Romanyuk AP. Osoblivosti vegetativnoyi regulyacyii sercya u sportsmeniv igrovih vidiv sportu ta legkoatletiv. [Peculiarities of autonomic regulation of the heart in athletes of game sports and track and field athletes] Visnik Harkivskogo nacionalnogo universitetu imeni V.N. Karazina. Seriya biologiya. 2016; 26: 187-195 (in Ukrainian).
- Bentley RF, Vecchiarelli E, Banks L et al. Heart rate variability and recovery following maximal exercise in endurance athletes and physically-active individuals. Appl Physiol Nutr Metab. 2020; 15. doi: 10.1139/apnm-2020-0154.
- Korobyeynikov GV, Dudnik OK, Radchenko YuA. Variabelnist sercevego ritmu u yunih borciv z riznim funkcionalnim stanom nervovoyi sistemi. [Heart rate variability in young wrestlers with different functional states of the nervous system] Pedagogika, psihologiya ta mediko-biologichni problemi fizichnogo viovannya i sportu: nauk.monogr. za red. Yermakov S.S. H.: HDADM. 2007; 6: 157-160. (in Ukrainian).
- Baek HJ, Cho CH, Cho J, Woo JM. Reliability of ultra-short-term analysis as a surrogate of standard 5-min analysis of heart rate variability. Telemed J E Health. 2015; 21:404-14. doi:10.1089/tmj.2014.0104.
- Bourdon PC, Cardinale M, Murray A et al. Monitoring Athlete Training Loads: Consensus Statement. International Journal of Sports Physiology and Performance. 2017; 12(2): 2161-2170. doi:10.1123/IJSP.2017-0208.
- Coelho AB, Nakamura FY, Morgado MC et al. Heart Rate Variability and Stress Recovery Responses during a Training Camp in Elite Young Canoe Sprint Athletes. Sports (Basel). 2019; 7(5). pii: E126. doi: 10.3390/sports7050126.
- Ivchenko OM, Mitova OO, M'yachin VG. Nechitko-logichna ekspertna sistema dlya integralnoyi ocinki rivnya specialnoyi fizichnoyi pidgotovlenosti basketbolistiv na etapi poperednoyi bazovoyi pidgotovki. [Fuzzy logical expert system for integral assessment of the level of special physical fitness of basketball players at the stage of preliminary basic training] HDAFKiS. 2023; 2 (28): 15-26. doi: 10.15391/si.2023-2.02.2023. (in Ukrainian).
- Bellenger CR, Fuller JT, Thomson RL et al. Monitoring Athletic Training Status Through Autonomic Heart Rate Regulation: A Systematic Review and Meta-Analysis. Sports Med. 2016; 46(10):1461-86. doi: 10.1007/s40279-016-0484-2.
- Bhati P, Moiz JA, Menon GR, Hussain ME. Does resistance training modulate cardiac autonomic control? A systematic review and meta-analysis. Clin Auton Res. 2019; 29(1):75-103. doi: 10.1007/s10286-018-0558-3.
- Fuentes-García JP, Villafaina S, Collado-Mateo D et al. Differences Between High vs. Low Performance Chess Players in Heart Rate Variability During Chess Problems. Front Psychol. 2019; 26;10: 409. doi: 10.3389/fpsyg.2019.00409.
- Cruz CJG, Rolim PS, Pires DS et al. Reliability of heart rate variability threshold and parasympathetic reactivation after a submaximal exercise test Motriz. Rio Claro. 2017; 23(1): 65-70. doi:10.1590/s1980-6574201700010010.
- Kalitka SV, Roda OV, Lavrenyuk VYe. Osoblivosti zmin variabelnosti sercevego ritmu u kvalifikovanih sportsmenok pri adaptaciyi do trenuvanih navantazhen z bigu na seredni distanciyi. [Peculiarities of changes in heart rate variability in qualified female athletes during adaptation to training loads from middle-distance running]. Sportyvna medycyna. 2016; 1: 69-76. (in Ukrainian).
- Shahlina LG. Osobennosti funkcionalnoj adaptacii organizma sportsmenok vysokoj kvalifikacii k bolshim fizicheskim nagruzkam. [Features of the functional adaptation of the body of highly qualified female athletes to high physical loads]. Sportyvna medycyna. 2012; 1: 20-30. (in Russian).
- Laborde S, Mosley E, Mertgen A. Vagal Tank Theory: The Three Rs of Cardiac Vagal Control Functioning – Resting, Reactivity, and Recovery. Front Neurosci. 2018; 12:458. doi: 10.3389/fnins.2018.00458.
- De Geus EJC, Gianaros PJ, Brindle RC et al. Should heart rate variability be "corrected" for heart rate? Biological, quantitative, and interpretive considerations. Psychophysiology. 2019; 56(2): e13287. doi: 10.1111/psyp.13287.
- Plews DJ, Laursen PB, Buchheit M. Day-to-day Heart Rate Variability (HRV) Recordings in World Champion Rowers: Appreciating Unique Athlete Characteristics. International Journal of Sports Physiology and Performance. 2016; 12(5):1-19. doi: 10.1123/ijsp.2016-0343.
- Vykulov AD, Nemyrov AD, Shevchenko AYU. Informativeness of heart rate parameters in sports training. Man and Universe. 2004; 4: 50-53.
- Morgan SJ, Mora JAM. Effect of Heart Rate Variability Biofeedback on Sport Performance, a Systematic Review. Appl Psychophysiol Biofeedback. 2017; 42(3): 235-245. doi: 10.1007/s10484-017-9364-2.
- Solovey OM, Mitova OO, Solovey DO et al. Analysis and generalization of competitive activity results of handball clubs in the game development aspect. Pedagogy of Physical Culture and Sports. 2020;24(1): 36-43. doi:10.15561/18189172.2020.0106.
- De Paula T, Neves MF, da Silva Itaborahy A et al. Acute Effect of Aerobic and Strength Exercise on Heart Rate Variability and Baroreflex Sensitivity in Men With Autonomic Dysfunction. J Strength Cond Res. 2019; 33(10):2743-2752. doi: 10.1519/JSC.0000000000002372.
- Egan-Shuttler JD, Edmonds R, Ives SJ. The Efficacy of Heart Rate Variability in Tracking Travel and Training Stress in Youth Female Rowers: A Preliminary Study. J Strength Cond Res. 2020 Nov;34(11):3293-3300. doi: 10.1519/JSC.0000000000002499.

24. Figueiredo DH, Figueiredo DH, Moreira A et al. Effect of Overload and Tapering on Individual Heart Rate Variability, Stress Tolerance, and Intermittent Running Performance in Soccer Players During a Preseason. *Strength Cond Res.* 2019; 33(5): 1222-1231. doi: 10.1519/JSC.0000000000003127.
25. Flatt AA, Esco MR, Nakamura FY. Association between Subjective Indicators of Recovery Status and Heart Rate Variability among Division-1 Sprint-Swimmers. *Sports (Basel).* 2018; 11; 6(3): 93. doi: 10.3390/sports6030093.
26. Kovalenko SO, Kudij LI. Variabelnist sercevego ritmu. Metodichni aspekti. Cherkasi: Cherkaskij nacionalnij universitet im. B. Hmelnyckogo. [Gert rate variability. Methodical aspects. Cherkasy: Cherkasy National University named after B. Khmelnytskyi] 2016, p.298 (in Ukrainian).
27. Korobeynikova LG, Korobeynikov GV, Radchenko YuA, Danko TN. Diagnostika psihofiziologichnogo stanu organizmu yak odna z klyuchovih problem sportivnoyi medicini. [Diagnosis of the psychophysiological state of the body as one of the key problems of sports medicine]. *Sportyvna medycyna.* 2016; 1: 3-10 (in Ukraine).
28. Lehrer PM, Gevirtz R. Heart rate variability biofeedback: how and why does it work? *Front Psychol.* 2014; 5:756. doi:10.3389/fpsyg.2014.00756.
29. Flatt AA, Globensky L, Bass E et al. Heart Rate Variability, Neuromuscular and Perceptual Recovery Following Resistance Training. *Sports (Basel).* 2019;7(10):225. doi: 10.3390/sports7100225.
30. Hernando D, Roca S, Sancho J et al. Validation of the Apple Watch for Heart Rate Variability Measurements During Relax and Mental Stress in Healthy Subjects. *Sensors (Basel).* 2018; 10; 18(8): 2619. doi: 10.3390/s18082619.
31. Holmes CJ, Wind SA, Esco MR. Heart Rate Variability Responses to an Undulating Resistance Training Program in Free-Living Conditions: A Case Study in a Collegiate Athlete. *Sports (Basel).* 2018; 6(4):121. doi: 10.3390/sports6040121.
32. Kamandulis S, Juodsnukis A, Stanislovaitiene J et al. Daily Resting Heart Rate Variability in Adolescent Swimmers during 11 Weeks of Training. *Int J Environ Res Public Health.* 2020; 22;17(6): 2097. doi: 10.3390/ijerph17062097.
33. Korobeynikov G, Pristupa Ye, Korobeynikova L, Briskin Yu. Ocinyuvannya psihofiziologichnih staniv u sporti: monografiya. [Assessment of psychophysiological conditions in sports: monograph] L.: LDUFK. 2013, p.222 (in Ukrainian).
34. Lysenko E, Shinkaruk O. The influence of sexual dimorphism and intense physical work on the manifestation of the neurodynamic properties of athletes. *Science and sport: current trends.* 2015; 1(6): 11-18.
35. Bachinskaya NV. Features of construction of structures in long-term training acrobatics at the modern stage. *Phys Educ Stud.* 2015; 1:3-10. doi: 10.15561/20755279.2015.0101.
36. Batechko DP, Martynuk OV. Doslidzhennya variabelnosti sercevego ritmu studentiv-sportsmeniv (yunakiv ta divchat), yaki specializuyutsya u futboli. [Study of heart rate variability of student-athletes (boys and girls) specializing in football]. *Sportyvni igry.* 2021; 4 (22): 4–14. doi: 10.15391/si.2021-4.01. (in Ukrainian).
37. Bosenko A et al. The state of the mechanisms of heart rhythm regulation in girls aged 7-16 years during their studies at school. *Visn Probl Biol Med.* 2017; 2: 395-401.
38. Harkovlyuk-Balakina, NV, Gorgo Yu.P. Tehnologii informacionnoj ocenki vegetativnoj regulyacii serdechnogo ritma u sportsmenov. [Technologies of information assessment of vegetative regulation of heart rhythm in athletes]. IX Mizhnarodnij naukovij kongres «Olimpijskij sport i sport dlya vsih» (20-23 veresnya 2005 r., Kiyiv, Ukrainyana). 2005, pp.243-244 (in Ukrainian).
39. Le Meur Y, Pichon A, Schaal K et al. Evidence of parasympathetic hyperactivity in functionally overreached athletes. *Med Sci Sports Exerc.* 2013; 45(11): 2061-71. doi: 10.1249/MSS.0b013e3182980125.
40. Kovalenko SO et al. Wave structure of hemodynamic parameters in people with the different baseline level of cardiac output and the blood supply of the thorax organs. *Visnyk Cherkas'koho universytetu: seriya biolohichni nauky.* 2019; 2.
41. Leicht AS, Halliday A, Sinclair WH et al. Heart rate variability responses to acute and repeated postexercise sauna in trained cyclists. *Appl Physiol Nutr Metab.* 2018; 43(7):704-710. doi: 10.1139/apnm.2017-0581.

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CONFLICT OF INTEREST

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THE EVALUATION OF THE FUNCTIONAL EXERCISE CAPACITY OF PATIENTS AFTER CARDIAC SURGERIES

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ABSTRACT

Aim: of the study was to analyze the impact of cardiac rehabilitation on the patients' performance measured with a 6-minute walk test, depending on age and type of a cardiac surgery.

Materials and Methods: The study group consisted of 144 patients (mean age 68.36 years old) after a cardiac surgery, who underwent physiotherapy in the Department of Cardiac Rehabilitation. The study group was divided into 4 age groups: 60-69-year-olds(56 people), 70-79-year-olds(47 people) and 80-89-year-olds(19 people), 22 people were less than 60 years old. Before and after the therapy, a 6-minute walk test was performed, the rehabilitation programme lasted from 3 to 5 weeks.

Results: The comparison of the results of the 6-minute walk test, in people before rehabilitation, the mean value of the 6MWT variable is significantly lower (equal to 1.3857) than after rehabilitation (equal to 2.5243), $p < 0.001$.

Conclusions: The implemetation of cardiac rehabilitation in cardiac surgery patients had a positive effect on the selected test.

KEY WORDS: geriatrics, cardiac rehabilitation, exercise capacity, 6-minute mars test, coronary artery bypass grafting, cut sternum, small thoracotomy, small incision under the breast, shunt

INTRODUCTION

The rate of involutory processes in the human body varies considerably, but physical exercises implemented in the elderly always result in an improvement in general physical fitness and an increase in muscle mass, especially respiratory muscle strength [1-4]. Changes in the circulatory system result from the body's natural processes, and early cardiac rehabilitation based mainly on exercise is an integral part of treatment in geriatrics [4]. Physiotherapy is an important therapeutic element in patients after acute myocardial infarction, in whom exercise tolerance, functional capacity, quality of life have improved, the number of hospitalizations and even death rate have decreased [5, 6]. Rehabilitation has also found an important place in cardiac surgery. Patients after coronary artery bypass grafting and aortic and mitral valve surgery undergo physical exercise [7]. The only element that is taken into account is the selection of tests for assessing progress in rehabilitation, adapted to the disability of older people.

AIM

The aim of the study was to analyze the impact of early cardiac rehabilitation on patients' performance assessed with the 6-minute walk test, depending on age and type of cardiac surgery.

MATERIALS AND METHODS

The research was being carried out for 3 years at the State Medical Institute of the Ministry of Interior and Administration.

The study group consisted of 144 patients of the Cardiac Rehabilitation Department of the Hospital of the Ministry of Interior and Administration in Warsaw, all of whom had previously been patients of the Cardiac Surgery Department of the same hospital. They had previously undergone procedures: coronary artery bypass grafting (CABG) or valve replacement (the so-called small thoracotomy, i.e. a small cut under the breast). Patients undergoing surgery with a cut of the sternum – 81.3%, without a cut of the sternum – 18.8%. The study group was divided into 4 age groups: 60-69-year-olds(56 people), 70-79-year-olds (47 people) and 80-89-year-olds (19 people), 22 people were less than 60 years old (Figure 1). 63.2% in the study group were men and 36.8% – women (Table 1).

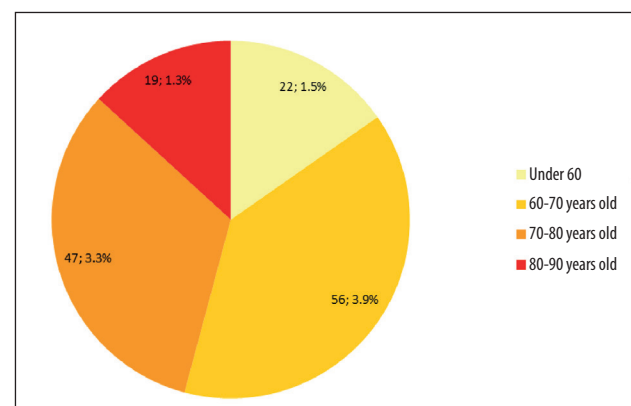


Figure 1. Structure of the study group by age

Table 1. Division of the study group by gender

	Men	Women	Together
N (%)	91 (63,2%)	53 (36,8%)	144 (100%)

Before starting the rehabilitation programme, each patient underwent a physiotherapeutic consultation and assessment, after prior consultation with the attending cardiologist. Based on its analysis and the result of a 6-minute-walk test, a rehabilitation programme lasting 3 to 5 weeks was developed. Everyone had breathing exercises and active free exercises in positions depending on the week of rehabilitation and the patient's abilities, marching training from Monday to Saturday inclusive (excluding Sundays).

Then, this measurement was performed after the end of therapy. Once a week, talks on physical exercise, the possibility of physical exercise, its validity and ways of taking care about the wound, were conducted.

Statistical analysis performed on the entire study group with calculation of means and confidence interval. The tests were performed at the significance level of $p < 0.05$.

RESULTS

The mean value of the 6-minute walk test in the subjects before rehabilitation was significantly lower (equal to 1.3857) than after rehabilitation (equal to 2.5243) $p < 0.001$.

Before rehabilitation, the mean score of the 6-minute walk test in the age group below 60 was 1.627, while after rehabilitation it was 2.764. In the 60-70 age group, before rehabilitation, the mean score of the 6-minute-walk test was 1.492, after rehabilitation - 2.794. Age group 70-80: before rehabilitation, the mean result of the 6-minute-walk test was 1.312, after rehabilitation the average was 2.386. In the 80-90 age group: before rehabilitation, the mean 6-minute-walk test score was 0.956, while after rehabilitation the mean was 1.767 (Table 2).

The mean values of the 6-minute walk test in the groups according to cardiac surgery before rehabilitation are presented in Figure 2.

In the group of patients under 60 without a split sternum, the mean value of 6MWT was 1.567, in the group with a split sternum the mean value of 6MWT was 1.068.

In the group of patients aged 60-70 without a cut sternum, the mean value of 6MWT was 1.071, in the group with a cut sternum the mean value of 6MWT was 1.386.

In the group of patients aged 70-80 without a cut sternum, the mean value of 6MWT was 1.356, in the group with a cut sternum the mean value of 6MWT was 1.000.

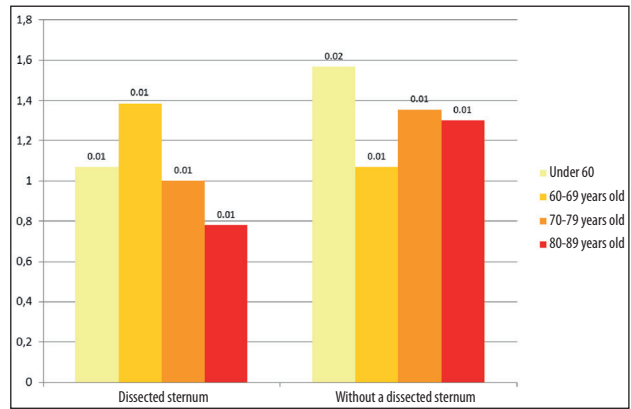


Figure 2. Mean values of 6MWT in groups according to cardiac procedure before rehabilitation

In the group of patients aged 80-90 without a split sternum, the mean value of 6MWT was 1.300, in the group with a split sternum the mean value of 6MWT was 0.782.

The length of stay from 3 to 5 weeks on the ward was not related to the improvement ($r = 0.16$; $p = 0.059$).

The mean values of the 6-minute walk test in the age groups according to cardiac surgery before and after rehabilitation are presented in Table 3.

In the group of patients under 60, without a dissected sternum, the mean value of 6MWT increased from 1.567 before rehabilitation to 2.542 after rehabilitation. In the group with a split sternum, the mean value of 6MWT before rehabilitation was 1.068, after rehabilitation it was 2.035.

In the group of patients aged 60-70 without a dissected sternum, the mean value of 6MWT increased from 1.071 to 2.150 after rehabilitation. In the split sternum group, the mean value of 6MWT was 1.386 before rehabilitation and 2.453 after rehabilitation.

In the group of patients aged 70-80 without a dissected sternum, the mean value of 6MWT was 1.356 before rehabilitation and 2.347 after rehabilitation. In the split sternum group, the mean 6MWT increased from 1,000 before rehabilitation to 1,548 after rehabilitation.

In the group of patients aged 80-90 without dissected sternum, the mean value of 6MWT was 1.300 before rehabilitation and 1.904 after rehabilitation. In the split sternum group, the mean value of 6MWT increased from 0.782 before rehabilitation to 1.205 after rehabilitation.

DISCUSSION

There are many ways to assess the mobility impairment in the elderly people. In geriatric age, the analysis of exercise responses to various types of tests (and their modification

Table 2. Mean values of 6MWT before and after rehabilitation

Age group	Average before rehabilitation	Average after rehabilitation	Confidence interval mean difference	N
Under 60	1,627	2,764	0,248	22
60-70 years old	1,492	2,794	0,205	56
70-80 years old	1,312	2,386	0,163	47
80-90 years old	0,956	1,767	0,197	19

Table 3. Mean values of 6MWT in groups according to cardiac procedure before and after rehabilitation

Group age	Cardiac procedure	Before rehabilitation	After rehabilitation	N
Under 60	Without a dissected sternum	1,567 ± 0,32	2,542 ± 0,35	3
	Dissected sternum	1,068 ± 0,11	2,035 ± 0,18	19
60-70 years old	Without a dissected sternum	1,071 ± 0,15	2,150 ± 0,97	14
	Dissected sternum	1,386 ± 0,25	2,453 ± 0,28	39
70-80 years old	Without a dissected sternum	1,356 ± 0,22	2,347 ± 0,26	9
	Dissected sternum	1,000 ± 0,12	1,548 ± 0,16	34
80-90 years old	Without a dissected sternum	1,300	1,904	1
	Dissected sternum	0,782 ± 0,14	1,205 ± 0,19	17

due to the presence of numerous comorbidities and impaired functions) makes it possible to undertake a multi-component treatment strategy [1-3, 8-12]. These include the widely used 6-minute walk test (6MWT). It does not require any complicated equipment or technical knowledge and provides an objective assessment of functional exercise capacity [8, 13, 14].

In this safe, low-complexity test, the patient is asked to walk in a corridor for a period of 6 minutes, with the primary outcome measure being a 6-minute walking distance (6MWD) measured in meters [9, 13]. Unlike functional tests, 6MWT picks up frequently for respiratory comorbidities, including some cardiovascular diseases, low muscle strength, sarcopenia, and cancer [8, 13, 15, 16]. It is advisable to pay attention to the methodology to make it reliable and comparable. Factors that may affect walking distance include track layout (continuous vs straight), track length, learning effect, and verbal encouragement [13, 17]. Although this test can be performed by children and adolescents, when performed in geriatric patients, it encounters many problems, resulting not only from involution but also from comorbidities [18-20].

Hence, there are often various modifications of the test, different time of the test, different distances and pace [21, 22]. There are some discussions among operators regarding the classification of geriatric patients for cardiac surgery, and these decisions are not easy [7, 23-26]. Bypass involves a direct access to the coronary vessels, cutting the chest structures and suturing a vein or artery. The material for creating a bridge can be, for example, the saphenous vein taken from the patient's lower leg, the left or right internal thoracic artery, and in selected cases the radial artery taken from the forearm, or an artificial vessel. Hence, this can result in additional mobility problems for an already less agile person, not only due to illness, age but also additional surgery on the lower limb or both lower extremities. Physical rehabilitation is a very important element of the treatment of patients after coronary artery bypass grafting (CABG), it

improves functional capacity, both short- and long-term exercise training [27]. Walking test and it is postulated to include riding a stationary bicycle in rehabilitation [28].

The publications also include the search for other methods in cardiac rehabilitation after bypass, such as traditional Chinese medicine (Shenmai) [27]. Heart valve surgery comes down to a less invasive intervention and, of course, a smaller scar (the so-called small thoracotomy, i.e., a small cut under the breast). The size and amount of scars affects the patient's activity as well as the exercise programme. Early cardiac rehabilitation is an important element of supporting the treatment of patients. Efficiency and effectiveness were proven long time ago. Properly conducted, it significantly restores the efficiency of the patient, especially the geriatric ones. The walk of a person, depending on the type of cardiac surgery, changes and is also dependent on the swelling on the lower extremities from which the vein was taken. In addition, there are still concomitant diseases of the musculoskeletal system, such as changes in the joints of the lower limbs and spine, balance disorders, vision and hearing disorders [11, 20, 29]. There are also difficulties in the analysis of the obtained test results [30, 31]. The assessment of the test is an important element of learning and what is essential is the whole process of kinesitherapy restoring the efficiency, functionality and especially independence of the elderly person. The effectiveness of early cardiac rehabilitation depends on the prior condition, complications during the operation and the healing process of the operated structures.

CONCLUSIONS

The stay on the ward of Cardiac Rehabilitation significantly influenced the results of the 6-minute walk test, each patient had better results, regardless of age. The length of stay from 3 to 5 weeks on the ward was not related to the improvement, while in the age group of 60-69, better test results were observed in patients with a cut sternum.

References

1. Díaz EG, Ramírez JA, Fernández NH et al. Effect of strength exercise with elastic bands and aerobic exercise in the treatment of frailty of the elderly patient with type 2 diabetes mellitus. *Endocrinol Diabetes Nutr (Engl Ed)*. 2019;66(9):563-570.
2. Marzetti E, Cesari M, Calvani R et al. SPRINTT Consortium. The „Sarcopenia and Physical fRailty IN older people: multi-component Treatment strategies“ (SPRINTT) randomized controlled trial: Case finding, screening and characteristics of eligible participants. *Exp Gerontol*. 2018;113:48-57.

3. Giua R, Pedone C, Scarlata S et al. Relationship between respiratory muscle strength and physical performance in elderly hospitalized patients. *Rejuvenation Res.* 2014;17(4):366-71.
4. Piotrowska M, Okrzymowska P, Kucharski W, Rożek-Piechura K. Application of Inspiratory Muscle Training to Improve Physical Tolerance in Older Patients with Ischemic Heart Failure. *Int J Environ Res Public Health.* 2021;18(23):12441.
5. Andjic M, Spiroski D, Ilic Stojanovic O et al. Effect of short-term exercise training in patients following acute myocardial infarction treated with primary percutaneous coronary intervention. *Eur J Phys Rehabil Med.* 2016;52(3):364-9.
6. El Missiri A, Amin SA, Tawfik IR, Shabana AM. Effect of a 6-week and 12-week cardiac rehabilitation programme on heart rate recovery. *Egypt Heart J.* 2020;72(1):69.
7. Gersak B, Sutlic Z. Aortic and mitral valve surgery on the beating heart is lowering cardiopulmonary bypass and aortic cross clamp time. *Heart Surg Forum.* 2002;5(2):182-6.
8. Bohannon RW, Crouch R. Minimal clinically important difference for change in 6-minute walk test distance of adults with pathology: a systematic review. *J Eval Clin Pract.* 2017;23(2):377-381.
9. Uszko-Lencer N, Mesquita R, Janssen E et al. Reliability, construct validity and determinants of the 6-minute walk test performance in patients with chronic heart failure. *Int J Cardiol.* 2017;240:285-290.
10. Uszko-Lencer N, Mesquita R, Janssen E et al. Reliability, construct validity and determinants of 6-minute walk test performance in patients with chronic heart failure. *Int J Cardiol.* 2017;240:285-290.
11. Lázaro M, Cuesta F, León A et al. Elderly patients with recurrent falls. Role of posturographic studies. *Med Clin (Barc).* 2005;124(6):207-10.
12. González-Ávila B, Roqueta C, Farriols C et al. Clinical application of the „Stop walking while talking test“. Relationship with geriatric assessment parameters and other tests of balance and walk. *Rev Esp Geriatr Gerontol.* 2017;52(2):61-64.
13. Agarwala P, Salzman SH. Six-Minute Walk Test: Clinical Role, Technique, Coding, and Reimbursement. *Chest.* 2020;157(3):603-611.
14. Eksombatchai D, Wongsinint T, Phongnarudech T et al. Pulmonary function and six-minute-walk test in patients after recovery from COVID-19: A prospective cohort study. *PLoS One.* 2021;16(9):e0257040.
15. Bokov P, Delclaux C. Interpretation and use of routine pulmonary function tests: Spirometry, static lung volumes, lung diffusion, arterial blood gas, methacholine challenge test and 6-minute walk test. *Rev Med Interne.* 2016;37(2):100-10.
16. Du H, Wonggom P, Tongpeth J, A Clark RA. Six-Minute Walk Test for Assessing Physical Functional Capacity in Chronic Heart Failure Affiliations. *Curr Heart Fail Rep.* 2017;14(3):158-166.
17. Lange-Maia BS, Newman AB, Strotmeyer ES et al. Performance in fast- and usual-paced 400-m walk tests in the elderly people: are they comparable? *Aging Clin Exp Res.* 2015;27(3):309-14.
18. Mylius CF, Paap D, Takken T. 6-minute walk test in children and adolescents: a systematic review. *Expert Rev Respir Med.* 2016;10(12):1335-1352.
19. Bohannon RW, Wang YC, Bubela D, Gershon RC. Normative Two-Minute Walk Test Distances for Boys and Girls 3 to 17 Years of Age. *Phys Occup Ther Pediatr.* 2018;38(1):39-45.
20. Ramírez AG, Nogal ML, Ribera Casado JM. Evaluation of postural control systems in elderly patients with repeated falls. *Rev Esp Geriatr Gerontol.* 2008;43(2):71-5.
21. Chan WLS, Pin TW. Reliability, validity and minimal detectable change of 2-minute walk test, 6-minute walk test and 10-meter walk test in frail the elderly people with dementia. *Exp Gerontol.* 2019;115:9-18.
22. Cheng DK, Nelson M, Brooks D, Salbach NM. Validation of stroke-specific protocols for the 10-meter walk test and 6-minute walk test conducted using 15-meter and 30-meter walkways. *Top Stroke Rehabil.* 2020;27(4):251-261.
23. Dell'Amore A, Aquino TM, Pagliaro M et al. Aortic valve replacement with and without combined coronary bypass grafts in very elderly patients: early and long-term results. *Eur J Cardiothorac Surg.* 2012;41(3):491-8.
24. Odell JA, Mullany CJ, Schaff HV et al. Aortic valve replacement after previous coronary artery bypass grafting. *Ann Thorac Surg.* 1996;62(5):1424-30.
25. Dagenais F, Mathieu P, Doyle D et al. Moderate aortic stenosis in coronary artery bypass grafting patients more than 70 years of age: to replace or not to replace? *Ann Thorac Surg.* 2010;90(5):1495-9.
26. Smith WT 4th, Ferguson TB Jr, Ryan T et al. Should coronary artery bypass graft surgery patients with mild or moderate aortic stenosis undergo concomitant aortic valve replacement? A decision analysis approach to the surgical dilemma. *J Am Coll Cardiol.* 2004;44(6):1241-7.
27. Zhang Ch, Zheng Y, Chen T et al. The utility of traditional Chinese medicine (Shenmai) in the cardiac rehabilitation after coronary artery bypass grafting: A single-center randomized clinical trial. *Complement Ther Med.* 2019;47:102203.
28. Diprat Trevisan M, Colvara Lopes DG, Bandeira de Mello RG et al. Alternative Physical Therapy Protocol Using a Cycle Ergometer During Hospital Rehabilitation of Coronary Artery Bypass Grafting: a Clinical Trial. *Braz J Cardiovasc Surg.* 2015;30(6):615-9.
29. Ibáñez JMF, Morales Ballesteros MC, Montiel Moreno M et al. Physical restraint use in relation to falls risk in a nursing home. *Rev Esp Geriatr Gerontol.* 2020;55(1):3-10.
30. Kamiya K, Adachi T, Kono Y et al. The 6-Minute Walk Test: difference in explanatory variables for performance by community-dwelling the elderly people and patients hospitalized for cardiac disease. *J Cardiopulm Rehabil Prev.* 2019;39(5):E8-E13.
31. Gray M, Paulson S, Powers M. Maximal, Not Habitual, Walking Velocity is More Highly Correlated to Functional Fitness of Community-Dwelling the elderly people. *J Aging Phys Act.* 2016;24(2):305-10.

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RESTORATION OF POSTURAL DISORDERS IN ADOLESCENTS USING SWIMMING EXERCISES

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ABSTRACT

Aim is to investigate the effectiveness of the author's methodology for the rehabilitation of adolescents with postural disorders (bilateral scoliotic deformities of the spine) using swimming exercises.

Materials and Methods: The research involved 40 adolescents (girls) aged 11 to 13 years with bilateral scoliosis of the 2nd degree. Two groups were formed (CG and EG) of 20 people. The author's methodology was used in the rehabilitation of adolescents of the EG. Breaststroke and backstroke swimming was used in the CG. The following indicators were studied: the angle of bending of the right- and left-side arch of the scoliotic deformity, deadlift of the torso dynamometer, dumbbell bench press, and push-ups from a bench.

Results: The author's methodology for the rehabilitation of postural disorders in adolescents based on the use of sidestroke swimming exercises and a special corset, which allows to fix one scoliotic deformity and carry out rehabilitation on the second deformity (bending) and vice versa, has been developed. Testing the effectiveness of the methodology shows that after rehabilitation, adolescents in the EG showed significantly better results than those in the CG in all studied indicators.

Conclusions: As a result of the training sessions according to the author's methodology with the use of the developed corset and sidestroke swimming, adolescents of the EG had a significant recovery of bilateral scoliotic deformities, strengthening of the muscular corset of the trunk, and improvement of the functional state of the main body systems and health.

KEY WORDS: postural disorders, bilateral scoliosis, corset, swimming, rehabilitation

INTRODUCTION

Exercises that stretch the spine in a water environment are effective enough to treat some abnormalities and postural disorders (hernias, nerve, and blood vessel compression) [1, 2], but they are not effective enough to correct bilateral scoliotic deformities. To restore bilateral scoliosis with Cobb scoliosis angles of up to 40 degrees, orthopedic corsets are used, for example, the Cheneau corset, which is a rigid structure made of special thermoplastic, in which bandages are located that act on individual parts of the spine [3]. There are other models, for example, Boston brace, Milwaukee, Stagnara, Charleston bending brace, Wilmington 25 brace, and Hans-Rudolf Weist [4]. Such corsets require almost round-the-clock wearing for 1-3 years or more. However, patients who use corsets complain of significant pain when wearing these corsets, domestic inconvenience, but most importantly, with their constant wearing, the back muscles that support the spine atrophy and are mummified. Surgical intervention is used in case of more significant spinal deformities.

In addition to wearing corsets, the method of therapeutic physical culture according to K. Schroth [5] is used to stop the progression of scoliosis and reduce the angle of curvature of the vertebrae. However, this technique

is imperfect, it works only in combination with wearing a corset and is aimed mainly at fixing the recovery of deformities in the corset through active exercises based on corrective asymmetric breathing, which is opposite to the scoliotic stereotype of respiratory movements of the chest.

The role of exercise in the correction of scoliosis is very important, but the development of effective methods for the rehabilitation of bilateral deformities is a very difficult task. Although there are recommendations for strengthening the muscular corset of the trunk [6, 7, 8], we did not find direct means and methods for the restoration of bilateral scoliosis using swimming in the available literature. Thus, there is a known methodology for strengthening the muscular corset of the spine and preventing further deformation of bilateral spinal scoliosis, which includes breaststroke and backstroke using symmetrical movements of the limbs [4, 5, 9]. The method allows the strengthening of the muscular corset of the spine and prevents its further deformation but does not provide directly forced correction of bilateral scoliotic curves of the spine.

There are also known methods of correcting unilateral human scoliosis using the sidestroke swimming method by extending the scoliotic deformities of the body lying

on the water with the convex part of the bend upward, while the human body bends downward during swimming, i. e. in the opposite direction to the scoliotic bend [10]. A variant of this method is the correction of unilateral scoliosis with predominant deformation of the upper segments of the spine using the sidestroke swimming and a swimming board, on which the lower extended forward arm rests – by strengthening the extension of scoliotic deformities of the body in the upper segments of the spine of a person lying on the water with the convex part of the bend upward, while the human body bends downward during swimming, that is, in the opposite direction to the scoliotic bend. Another option for correcting unilateral scoliosis with predominant deformity of the lower spinal segments is to use the sidestroke swimming method and a swimming board on which the lower part of the thigh rests [11, 12]. However, these methods cannot be used to correct bilateral spinal deformities, as one curvature will be corrected and the other will be aggravated.

AIM

The aim is to investigate the effectiveness of the author's methodology for the rehabilitation of adolescents with postural disorders (bilateral scoliotic deformities of the spine) using swimming exercises.

MATERIALS AND METHODS

The research involved 40 adolescents (girls) with bilateral scoliosis. The research was conducted in 2020-2022. Two groups of adolescents were formed (control (CG) and experimental group (EG)) – girls aged 11 to 13 years (20 people in each group) who had certain variants of bilateral (S-shaped) scoliosis of the 2nd degree (from 10 to 25 degrees according to Cobb) [5]. There was no special selection of adolescents in the CG and EG, the groups were formed randomly. In the rehabilitation of the EG adolescents, we used the methodology proposed by us – swimming alternately on the right and then on the left side with the use of the corset developed by us. In the CG, breaststroke and backstroke swimming with symmetrical movements of the limbs was used. Individual rehabilitation lasted 10 months. The following indicators were recorded before and after rehabilitation: the angle of bending of the right-

side arch of the scoliotic deformity, the angle of bending of the left-side arch of the scoliotic deformity, deadlift of the torso dynamometer, 2 kg dumbbell bench press, push-ups from a bench.

The corset we developed had a rigid lateral bandage made of a plastic profile on one side and a soft bandage on the other, which were connected by straps. The corset allows fixing the scoliotic curve on the convex side by tightening the straps, which makes it impossible to further bend it while swimming on the side with the scoliotic curve downward, which is in the corset. At the same time, the other scoliotic curve is convex side up. During swimming, the patient's body bends downward and straightens this convexity by swimming on the side. Thus, we fixed one scoliotic curve with the help of a corset and worked with the second one using known variants of sidestroke swimming. After that, we repositioned the corset to the second scoliotic curve, the patient turned to the other side and performed sidestroke swimming.

Before the experiment, the groups of adolescents were tested for normal distribution using the Kolmogorov-Smirnov test in IBM SPSS Statistics 23.0. The distributions were found to be normal, which allowed for statistical calculations using Student's t-test.

The process of conducting this research is based on the relevant ethical rules. First of all, all ethical requirements were considered before conducting this research. Then the authors obtained the consent of the Ethics Committees of Kyiv National University of Technology and Design and Ukrainian State Dragomanov University. After that, the participants were informed about the aim and tasks of the research. They were also informed that participation in the research was voluntary, and they had the right to withdraw at any time. The participants were adolescents, so we also obtained permission from their parents for their children to participate in the research.

RESULTS

Table 1 shows the results of the study of certain indicators (the angle of bending of the left- and right-side arch of the scoliotic deformity, deadlift of the torso dynamometer, 2 kg dumbbell bench press, push-ups from a bench) in adolescents before the start of their rehabilitation.

Table 1. Indicators of bending angles of the scoliotic arch and strength capabilities in the CG and EG adolescents before rehabilitation

Indicators	CG (n = 20)	EG (n = 20)	Difference in %	p (t)
The angle of bending of the right-side arch of the scoliotic deformity (degrees)	18.31 ± 1.28	18.77 ± 1.36	2.53	> 0.05 (1.102)
The angle of bending of the left-side arch of the scoliotic deformity (degrees)	17.90 ± 1.43	18.28 ± 1.57	2.14	> 0.05 (0.800)
Deadlift of the torso dynamometer (kg)	5.31 ± 0.36	5.20 ± 0.36	2.03	> 0.05 (0.843)
2 kg dumbbell bench press (number of times)	6.20 ± 0.42	6.07 ± 0.40	2.09	> 0.05 (1.002)
Push-ups from a bench (number of times)	3.50 ± 0.28	3.41 ± 0.34	2.48	> 0.05 (0.914)

Explanatory note: $t_{\alpha} = 2.024$ ($p < 0.05$)

It was found that before the start of rehabilitation (at the beginning of the experiment) there was no significant difference between the EG and CG in all studied indicators ($p > 0.05$).

The author's methodology includes four traditional parts: a warm relaxing shower, warm-ups on land and in water, a certain amount of recovery swimming according to the individual capabilities of adolescents, and exercises to relax and calm breathing. The first stage of training sessions, which lasted from two to four weeks, included teaching adolescents who already knew how to stay on the water and move in non-sporting ways, sidestroke swimming, and simplified breaststroke and backstroke techniques with symmetrical arm movements. During the second stage, we continued to improve the sidestroke swimming with the use of a corset, and with a small amount of swimming in simplified breaststroke and backstroke. The main volume of sidestroke swimming was from 400 to 800 meters. The adolescent's body was wearing a corset that has a rigid, inflexible profile of the lateral bandage and with its soft straps tightens, especially in the place of the greatest curvature of the scoliotic arch, and fixes the first downwardly deformed part of the spine from further curvature by the lower lateral rigid and upper lateral soft bandages, (and to some extent corrects the existing curvature), which allows using sidestroke swimming to correct the second scoliotic deformity of the spine of a person lying on the water with the convex part of the second bend upwards. In this case, after completing the available, individually planned volume of specialized corrective swimming, the corset is put on the other side and the second area of bilateral scoliosis, and the patient turns over to the opposite side and continues to perform the planned volume of swimming at a slow pace on the side to correct the first scoliotic curvature. The ratio of the duration of swimming on each side depends on the degree of curvature of the first and second deformities. The training session lasted three times a week for 60-65 minutes (shower 5-10 minutes, warm-up on land 10 minutes, in water 5 minutes, main part 30 minutes, final part 5-10 minutes) for 10 months with adjustment of the volume and speed of recovery swimming depending on changes in functional status. The heart rate should not exceed the individual level of the threshold of anaerobic metabolism.

After 10 months of rehabilitation (at the end of the experiment) we conducted a study to evaluate the effectiveness of the author's methodology using the same indicators as before the start of rehabilitation. It was found that by all the studied parameters, the EG adolescents performed significantly ($p < 0.0001$) better at the end of the experiment than the CG adolescents (Table 2). Thus, the difference between indicators of the angle of bending of the right-side arch of the scoliotic deformity in the EG and CG is -10.59 degrees; the angle of bending of the left-side arch of the scoliotic deformity -10.57 degrees; deadlift of the torso dynamometer -4.2 kg; 2 kg dumbbell bench press -4.9 times; push-ups from a bench -2.79 times.

Thus, the research on individual recovery of bilateral (S-shaped) scoliosis in girls aged 11-13 years in the EG shows a positive result. The scoliotic deformity decreased almost three times in 10 months in all 20 girls. The patients felt well, and after the rehabilitation course, most of them voluntarily continued swimming in other health groups and swimming pools to strengthen the muscular corset of the torso and consolidate the results of recovery. The trunk muscle strength of the EG girls increased on average twofold. The CG adolescents also showed positive dynamics of indicators in the process of rehabilitation, but the CG revealed weaker results at the end of the experiment: the scoliotic arch of deformation decreased by an average of 1-1.8 degrees, indicators of trunk muscle strength increased by an average of 10-11 %, which is significantly inferior to the indicators of the EG girls.

DISCUSSION

In our opinion, the use of Cheneau corsets or corsets of other modifications, including Hans-Rudolf Weist, is ineffective, because no matter how perfect the corset is, it must constantly exert pressure on the vertebrae of the spine, forcing them to deform, albeit in the opposite direction (otherwise we will not have a restorative effect), but this action still causes pain. There are also domestic inconveniences, especially in the warm season when the body sweats a lot under the corset, and the skin causes itching, which is especially difficult for teenagers. In addition, with prolonged wearing of the corset, the functions of the muscles are taken over by the corset, and the muscles atrophy from inactivity, as evidenced by a decrease in

Table 2. Indicators of bending angles of the scoliotic arch and strength capabilities in the CG and EG adolescents after rehabilitation

Indicators	CG (n = 20)	EG (n = 20)	Difference in %	p (t)
The angle of bending of the right-side arch of the scoliotic deformity (degrees)	16.25 ± 0.85	5.66 ± 0.56	65.19	< 0.0001 (46.528)
The angle of bending of the left-side arch of the scoliotic deformity (degrees)	16.04 ± 0.87	5.47 ± 0.39	65.89	< 0.0001 (49.580)
Deadlift of the torso dynamometer (kg)	6.08 ± 0.45	10.28 ± 0.65	69.14	< 0.0001 (23.759)
2 kg dumbbell bench press (number of times)	7.12 ± 0.48	12.02 ± 0.93	68.79	< 0.0001 (20.938)
Push-ups from a bench (number of times)	3.99 ± 0.24	6.78 ± 0.47	69.88	< 0.0001 (23.643)

Explanatory note: $t_{\alpha} = 3.566$ ($p < 0.0001$)

muscle volume, and a decrease in their tone and strength [13]. That is, after the end of treatment, in conditions of a weakened or even atrophied muscle corset of the trunk, the resistance of the spine to new deformations is almost absent, which can cause a relapse of new disorders [14].

The methodology of therapeutic physical culture according to K. Schroth somewhat offsets these consequences, but this methodology is imperfect, it works only in combination with wearing a corset and is aimed mainly at fixing the correction of the deformity in the corset through active exercises based on corrective asymmetric breathing, which is opposite to the scoliotic stereotype of respiratory movements of the chest while wearing a corset [4]. There are other methodologies in which side bends i. e. the main anti-scoliotic exercises are ineffective since there are two curvatures in bilateral scoliosis and we will restore one and strengthen the other. The same dilemma arises when applying exercises in water – symmetrical exercises have only a general strengthening and healing effect, and asymmetrical exercises are effective only in unilateral scoliosis [15, 16]. We found a solution to this problem in the development and use of a special corset, which, unlike the ones discussed above, does not exert pressure on deformed vertebrae, but only fixes the position of one deformed curvature during recreational swimming to be able to apply asymmetric exercises to another deformed part of the spine. The result of the author's proposed methodology is the possibility of restoring alternately deformed spinal segments in bilateral scoliosis by introducing a specialized corset that fixes the curvature on one side for the period of work on restoring the other curvature. Until now, there have been no means of direct action on the curved segment of the spine in bilateral scoliosis, as general means of strengthening the spinal muscles by breaststroke or backstroke swimming, which tone the spine, but do not directly affect the deformed segments of the spine, have been proposed and used. This conclusion is confirmed by the results of the CG and EG. The insignificant results of posture rehabilitation in the CG are because they performed only symmetrical swimming exercises that tone and strengthen the muscles of the trunk corset, but do not have a direct effect on the curves of scoliotic deformities. Whereas swimming exercises in the EG girls directly affected the curves of scoliotic deformities, making their correction possible.

It should be noted that the main task of the corset developed by us is only to fix the scoliotic curvature during rehabilitation swimming exercises, so its fixation on the patient's body does not cause pain, and the main restorative effect is on the second scoliotic curvature by sidestroke swimming.

The advantages of the author's methodology are: 1) water is a favorable environment for performing rehabilitation exercises, especially for the spine, since these exercises are performed in conditions similar to weightlessness and in a supine position, which eliminates unwanted pressure of the upper body on the vertebrae, promotes their decompression and restoration of injured or deformed

areas, blood flow is increased, stagnation in the vertebral vessels and lungs is eliminated, respiratory muscles are actively trained, pulmonary ventilation, lung capacity, blood oxygen saturation are increased, and the functioning and condition of the cardiovascular system is activated. 2) specialized soft exercises of sidestroke swimming due to the determined position of the body parts allow to correct scoliosis, increase the extensor effect on the scoliotic arch of unilateral scoliosis, but in the case of bilateral scoliosis we came across a contradiction – one segment of the arch is corrected while performing sidestroke swimming, the other is subjected to increased bending action, which increases its deformation, but the use of our proposed corset allows to eliminate this contradiction. During swimming, we correct one segment of the arch, fix the other with corset straps in a stable position and even straighten it to some extent by pressing the bend of the most deformed segment of the arch with straps to a rigid bandage, which is made of plastic and has stiffness and elasticity profiles on the side opposite to the body, low weight and resistance to water conditions, and is sheathed on both sides with durable material. It is possible to enhance the recovery of scoliosis in the upper thoracic region by using a swimming board under the lower arm extended forward, while the recovery of deformities of the lower spinal segments is possible by using a board under the hip while performing sidestroke swimming. 3) the proposed methodology has a special restorative effect for adolescents in primary and secondary school age, as the child's bones have not yet reached the stage of complete ossification and are relatively easy to treat with appropriate means. The results obtained extend the findings of scientists in this field [17-21].

CONCLUSIONS

The author's methodology for rehabilitation of adolescents with postural disorders (bilateral scoliotic deformities of the spine) using swimming exercises was developed, the essence of which is to perform preparatory exercises and sidestroke swimming using the corset developed by us on one side of the body and then on the other. The volume of swimming was selected in proportion to one spinal curvature and the other, as well as to the age, gender, concomitant diseases, and functional state of each adolescent. Relaxation and breathing exercises were performed at the end of the training session. Throughout the training session, each patient's heart rate was regularly determined by palpation, provided that the swimming intensity was within the individual threshold of anaerobic metabolism. The special corset developed by us allows us to fix one of the scoliotic curvatures from further deformation while performing sidestroke swimming, and to restore the other scoliotic curvature by performing therapeutic swimming exercises. After performing a certain amount of exercises, the patient would turn over to the other side and fix the corset on the second scoliotic curvature, which allows for restoring the first scoliotic curvature.

Testing the effectiveness of the author's methodology during 10 months of rehabilitation showed that the EG

adolescents showed a significant improvement in all studied indicators compared to the CG. At the end of the experiment, significantly better results were found in the EG girls than in the CG in terms of the angle of bending of the right-side arch of the scoliotic deformity – by 10.59 degrees; the angle of bending of the left-side arch of the scoliotic deformity – by 10.57 degrees; deadlift of the torso dynamometer – by 4.2 kg; 2 kg dumbbell bench press – by 4.9 times; push-ups from a bench – by 2.79

times. It has been established that as a result of swimming exercises according to the author's methodology using the corset developed by us, all 20 EG girls got rid of significant bilateral scoliotic deformities, strengthened the muscular corset of the trunk, and their functional state and health.

We see prospects for further research in the implementation of the author's methodology in the process of rehabilitation of older patients and testing its effectiveness.

References

1. Shi Z, Zhou H, Lu L, et al. Aquatic Exercises in the Treatment of Low Back Pain: A Systematic Review of the Literature and Meta-Analysis of Eight Studies. *Am J Phys Med Rehabil.* 2018;97(2):116-122. doi:10.1097/PHM.0000000000000801
2. Filatova Z, Yevtushok M, Okhrimenko I, et al. Strengthening the physical and mental health of students during swimming classes. *Acta Balneol.* 2022; 3(169): 240-245. doi: 10.36740/ABAL202203107
3. Kashuba V, Savliuk S, Chalii L, et al. Technology for correcting postural disorders in primary school-age children with hearing impairment during physical education. *J Phys Educ Sport.* 2020; 20(Suppl 2); 939-945. doi: 10.7752/jpes.2020.s2133
4. Kashuba V, Kolos M, Rudnytskyi O, et al. Modern approaches to improving body constitution of female students within physical education classes. *J Phys Educ Sport.* 2017; 17(4); 2472-2476. doi: 10.7752/jpes.2017.04277
5. Briskin Yu, Odinets T., Pitin M., Sidorko O. Health swimming: textbook. Lviv: LDUFK, 2017; 200 p. (in Ukrainian)
6. Willcox-Pidgeon SM, Peden AE, Scarr J. Exploring children's participation in commercial swimming lessons through the social determinants of health. *Health Promot J Austr.* 2021;32(2):172-181. doi:10.1002/hpja.335
7. Waller B, Lambeck J, Daly D. Therapeutic aquatic exercise in the treatment of low back pain: a systematic review. *Clin Rehabil.* 2009;23(1):3-14. doi:10.1177/0269215508097856
8. Dundar U, Solak O, Yigit I, Evcik D, Kavuncu V. Clinical effectiveness of aquatic exercise to treat chronic low back pain: a randomized controlled trial. *Spine (Phila Pa 1976).* 2009;34(14):1436-1440. doi:10.1097/BRS.0b013e3181a79618
9. Baena-Beato PÁ, Artero EG, Arroyo-Morales M, Robles-Fuentes A, Gatto-Cardia MC, Delgado-Fernández M. Aquatic therapy improves pain, disability, quality of life, body composition and fitness in sedentary adults with chronic low back pain. A controlled clinical trial. *Clin Rehabil.* 2014;28(4):350-360. doi:10.1177/0269215513504943
10. Campo AR, Pacichana-Quinayáz SG, Bonilla-Escobar FJ, et al. Effectiveness of Hydrotherapy on Neuropathic Pain and Pain Catastrophization in Patients With Spinal Cord Injury: Protocol for a Pilot Trial Study. *JMIR Res Protoc.* 2022;11(4):e37255. Published 2022 Apr 29. doi:10.2196/37255
11. Aure OF, Nilsen JH, Vasseljen O. Manual therapy and exercise therapy in patients with chronic low back pain: a randomized, controlled trial with 1-year follow-up. *Spine (Phila Pa 1976).* 2003;28(6):525-532. doi:10.1097/01.BRS.0000049921.04200.A6
12. Ma J, Zhang T, He Y, Li X, Chen H, Zhao Q. Effect of aquatic physical therapy on chronic low back pain: a systematic review and meta-analysis. *BMC Musculoskelet Disord.* 2022;23(1):1050. Published 2022 Dec 2. doi:10.1186/s12891-022-05981-8
13. Barker AL, Talevski J, Morello RT, Brand CA, Rahmann AE, Urquhart DM. Effectiveness of aquatic exercise for musculoskeletal conditions: a meta-analysis. *Arch Phys Med Rehabil.* 2014;95(9):1776-1786. doi:10.1016/j.apmr.2014.04.005
14. Wirth K, Keiner M, Fuhrmann S, Nimrichter A, Haff GG. Strength Training in Swimming. *Int J Environ Res Public Health.* 2022;19(9):5369. Published 2022 Apr 28. doi:10.3390/ijerph19095369
15. Silva LAD, Doyenart R, Henrique Salvan P, et al. Swimming training improves mental health parameters, cognition and motor coordination in children with Attention Deficit Hyperactivity Disorder. *Int J Environ Health Res.* 2020;30(5):584-592. doi:10.1080/09603123.2019.1612041
16. Hsu HC, Chou SW, Chen CP, Wong AM, Chen CK, Hong JP. Effects of swimming on eye hand coordination and balance in the elderly. *J Nutr Health Aging.* 2010;14(8):692-695. doi:10.1007/s12603-010-0134-6
17. Kiran T, Pinto AD. Swimming 'upstream' to tackle the social determinants of health. *BMJ Qual Saf.* 2016;25(3):138-140. doi:10.1136/bmjqs-2015-005008
18. Shoemaker LN, Wilson LC, Lucas SJE, Machado L, Thomas KN, Cotter JD. Swimming-related effects on cerebrovascular and cognitive function. *Physiol Rep.* 2019;7(20):e14247. doi:10.14814/phy2.14247
19. Griban G, Filatova O, Bosenko A, et al. Water in students' life and its impact on their health. *Acta Balneol.* 2021; 2 (164): 99-104. doi: 10.36740/ABAL202102104
20. Gasper A. Can swimming alleviate the burden of ill health and promote wellbeing?. *Br J Nurs.* 2017;26(15):896-897. doi:10.12968/bjon.2017.26.15.896
21. Dufour N, Thamsborg G, Oefeldt A, Lundsgaard C, Stender S. Treatment of chronic low back pain: a randomized, clinical trial comparing group-based multidisciplinary biopsychosocial rehabilitation and intensive individual therapist-assisted back muscle strengthening exercises. *Spine (Phila Pa 1976).* 2010;35(5):469-476. doi:10.1097/BRS.0b013e3181b8db2e

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PROJECTING OF HEALTH PROGRAMS FOR POST-COVID PATIENTS AT FITNESS CENTERS

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ABSTRACT

Aim: To develop and substantiate a complex health and fitness program «Fitness Energy» for restoration of health of people who suffered from COVID-19 and experimentally verify its effectiveness at fitness centers.

Materials and Methods: As a part of the research the complex assessment of somatic health status of people who suffered from COVID-19 was made using tests (Ruffier-Dickson Index, Stange and Gencha tests, Harvard step test, absolute and relative PWC 170).

Results: The health and fitness program «Fitness Energy» is developed, implemented and experimentally verified as a complex of selective breathing and aerobic exercises which are done in a particular order and allow acting deliberately on human body of people who suffered from COVID-19 to secure the maximum health-improvement effect.

Conclusions: Experimental research confirmed the effectiveness of health and fitness program «Fitness Energy», in particular the overall result upon indications of functional status of people in experimental group (25,78%) 17,5% higher than in control one (8,22%). This indicates the effectiveness of rehabilitation patients, in particular, improves the cardiovascular and respiratory systems, strengthens the muscles involved in respiration, increases the overall tone and efficiency of the body.

KEY WORDS: health programs, post-covid patients, fitness centers

INTRODUCTION

In November 2002 in People's Republic of China for the first time ever was registered the unknown form of atypical pneumonia which in five months was spread in 37 countries and endangered humanity health. In 2003 World Health Organization (WHO) officially named it Severe Acute Respiratory Syndrome (SARS). Fortunately, the effect of epidemic didn't concern Ukraine, but the next one which emerged in Chinese town Wuhan in November 2019 surpass the scope of the previous one and turned lives of Ukrainians around. Respiratory disease got the name of coronavirus disease of 2019 (COVID-19). Ministry of Health data analysis proved that since the beginning of the pandemic in Ukraine more than 1 million people suffered from COVID-19 (as of December 2021) and need rehabilitation; people aged 30–49 years suffered the most (almost 38%). Cohort study published by special medical resource «The Lancet» reported that most of the time the long-lasting effects of SARS-CoV-2 infection include muscle ache, tiredness and different mental disorders. Hence, people who suffered from COVID-19 and recovered feel continuous weakness, incapacity for work, so they need immediate rehabilitation independently of the degree of severity.

Scientist Scudellari M. it was figured out that COVID-19 symptoms are not associated with the phases of expanded virus population in individual cells [1]. The symptoms are not

expressed after the infection by the virus and its interaction with cells before the replication of ribonucleic acid (RNA). The first disease symptoms include body temperature rise and cough (the first phase of disease). The second phase is related to the significant viral replication (supposedly, in different organs) and followed by very high temperature, general weakness and symptoms which are specifically attributed to pneumonia. Disease progression results in the final phase – acute respiratory distress syndrome – ARDS. In spite of the fact that SARS-CoV-2 virus is considered a respiratory disease, it can harm kidneys, liver, heart and almost every organ system. Pathogenesis of COVID-19 is based on cellular damage caused by two mechanisms: direct cytotoxic action of SARS-CoV-2 virus, and overreaction to the immune system virus (strong inflammation, cytokine storm, killer cells attack).

Scientist Mizutani T. note that coronavirus causes fulguration and formation of fibrous adhesions in lungs after the cure [2]. The virus causes salt and water metabolism disorder and interrupts proteins transport due to the induction of cell fusion and effect on their membrane permeability which causes an alveolus collapse and pulmonary distress syndrome (life-threatening inflammatory respiratory disease).

Scientists Golubovskaya O. et al. make out the following clinical variants of disease development: uncomplicated cases with nonspecific symptoms; pneumonia without signs of respiratory disease; pneumonia with signs of

respiratory disease; acute respiratory distress-syndrome; sepsis; endotoxic shock [3].

In a study conducted Vysochyna I. L. et al. it is noted that in COVID-19 comorbidity with hypertension, coronary heart disease, diabetes mellitus, systemic connective tissue diseases the risks, course, prognosis and development of vascular complications significantly increase [4]. The severity of the inflammatory process and predicting the likelihood of complications is accompanied by changes in laboratory indicators, namely: in the general blood test – leukocytosis, an increase in the level of neutrophilic granulocytes, a decrease in the content of hemoglobin and platelets; in biochemical indicators – a decrease in the level of the general protein, an increase in the indicators of alanintransferase, aspartaminotransferase, C-reactive protein, lactatdehydrogenase, ferritin; coagulation changes – increase in the level of fibrinogen, D-dimer, reduction of activated partial thromboplastic time.

The authors Szczegieliński J. et al. suggest implementing an immediate rehabilitation program in post-infection patients as data from previous epidemics of respiratory-related viral diseases shows that COVID-19 survivors should be expected to have impaired lung ventilation function, and reduced exercise tolerance and muscular weakness, and prolonged return to work and participation [5].

Scientists Coudeyre E. et al. note that severe COVID 19 infection can cause a variety of respiratory and neuromuscular damage both in the acute phase and at distance from the initial infection [6]. Rehabilitation should be offered at every stages of the infection. Due to a lack of evidence based data, this management is based on published data for severe respiratory infections such as SARS and expert opinion. It should combine muscle strengthening, exercise reconditioning and more specific respiratory physiotherapy for certain patients.

In particular, we noticed a demand for scientifically proved health programs for post-COVID patients. The research hypothesis was generated on the assumption that health program «Fitness Energy» is developed for post-COVID patients rehabilitation which requires the organization of system complex training process at fitness centers and provides pre-dosed performing the breathing and special aerobic physical exercises, secures the improvement of cardiovascular and respiratory systems work, strengthening of muscles activated in breathing and working capacity increase.

AIM

The aim of the research is to develop and substantiate a complex health and fitness program «Fitness Energy» for restoration of health of people who suffered from COVID-19 and experimentally verify its effectiveness at fitness centers.

MATERIALS AND METHODS

On the first stage (September 2021) we analyzed the literary sources; substantiated the basic research conception and experimental work organization; fixed the research object, its aim and tasks; held the interviews with people (their

exercise motivation, demands and problems in health status were found out); completed a check upon indications of functional status and general working capacity level; based on the results obtained we formed control and experimental groups; made a model of the experimental program «Fitness Energy» which is developed to secure the functional status improvement and general working capacity level increase. The second stage (September – January 2021–2022 – 16 weeks) was aimed at the implementation of the program «Fitness Energy». On the third stage (January – February 2022) we completed a control check of health status according to the defined criteria.

52 people of 30–49 years who suffered from COVID-19 too part in the experiment (at running of experiment all of them had negative test). By random choice the participants of experiment were divided into two groups (control and experimental) with 26 people in each one. The experimental group did the exercises from program «Fitness Energy» at different fitness centers; the control group didn't do any exercises (people who visited fitness centers before the disease, but whose rehabilitation process took course the natural way under the care of family doctor).

To get the valid data about the health status of people who suffered from COVID-19 we made a complex assessment according to the following criteria [7]:

1. Body systems functional status (cardiovascular and respiratory systems). Status of cardiovascular system was assessed using Ruffier-Dickson Index; respiratory system was characterized by Stange and Gencha tests. Tooling: stop-watch.

Ruffier-Dickson testing procedure: after 5-minute resting state in a seated position a heart rate was being measured during 15 seconds (R1); next the patients did 30 squats in 45 seconds. Then a heart rate was being measured during the first three times during 30 seconds) and followed by three 30-second breaks. To calculate the index we used the following formula: $t \times 100 / (f_1 + f_2 + f_3) \times 2$, where «t» stands for test running time (5 minutes); «f1», «f2», «f3» stand for the heart rate during the first 30 seconds of second, third and fourth minutes of rest 15 seconds (R2) and the last 15 seconds (R3) of first minute of resting state. The Ruffier-Dickson Index was calculated by the formula: $4 \times (R_1 + R_2 + R_3) - 200 / 10$.

Stange testing procedure. After 5-minute resting state in a standing posture a heart rate was being measured during 30 seconds. Then the patients inhaled 3 times to a 3/4 depth and held the breath on a full inhale. Time of breath hold was fixed in seconds. Right after the breath regain a heart rate was being measured during 30 seconds (Table 1).

Gencha testing procedure. Breath is held after the full exhale. The time of breath hold of healthy untrained people hover around 25–40 seconds for men and 15–30 seconds for women. In respiratory organ virulent disease the time of breath hold during inhale and exhale is to be cut down, so the average time is 25 seconds (Table 1).

2. General working capacity level was calculated on a basis of PWC 170 test with calculations of absolute and

Table 1. Indices and levels of functional status assessment

Indices and measurement units	Levels				
	high	high-medium	medium	low-medium	low
Ruffier-Dickson Index (c.u.)	0–4	5–9		10–14	15 i >
Stange test (sec)	50	30–50		20–30	<20
Gencha test (sec)	40	30	25	15	10
Step test (c.u.)	> 90	86–90	77–85	61–70	<60
PWC 170 absolute (kgm/min)	850	750–849	550–749	450–549	<449
PWC 170 relative (kgm/min)	21–23	19–20	17–18	15–16	14
MCC (ml/min/kg)	>40	36–40	35–30	29–23	<23

relative indices, and Harvard step test. Tooling: stationary bicycle, stop-watch, stepper 43 cm high, pacer. PWC170 was calculated by the formula: $W1 + (W2 - W1) (170 - f1) / (f2 - f1)$, where «PWC170» stands for power working capacity on stationary bicycle when the heart rate is equal to 170 beats/min.; «W» and «W2» stand for the power of the first and second sessions, kgm/min. or W; «f1» and «f2» stand for the heart rate at the end of the first and second sessions.

Harvard step testing procedure. During 5 minutes at a sustainable pace a person went up and down a platform. The pace was set by a pacer with a customized rate 120 beats/min. A number of cycles (up-down) came to 30 per 1 minute. A session was followed by a 1-minute rest. During the second, third and fourth minutes the heart rate was being measured during 30 seconds (Table 1).

Patients with medium or serious disease progression need the recovery after coronavirus disease. Content of recovery and rehabilitation programs is to differ for every patient category. In light or latent coronavirus disease it is important to adhere to doctor's recommendations on prevention of development of complications. The patients with changes in pulmonary parenchyma by «frosted glass» type need respiratory rehabilitation under the supervision of a specialist.

Two types of rehabilitation have been identified: pulmonary rehabilitation – adjustment of lung volume which is secured by breathing exercises and physiotherapeutic procedure; general rehabilitation – functional recovery of lungs and other vital organs involved in intoxication level lowering (for example, functional recovery of kidneys and liver). The

Table 2. «Fitness Energy» program exercises

Exercise title and description	Measuring	Recommended practices	Functional use
«Pump». P.p. – stride position. Reaching forward with a loud sniff. P.p. – exhale through the mouth.	32 raps	Don't tense muscles. Have a rest after every 8 reps.	Respiratory system recovery, facilitating to full expectorated sputum clearance.
«Ring». P.p. – stride position, a ring ahead. Press a ring during exhaling and relax during inhaling.	10–15 raps	Elbows sideward, don't press to body.	Exercise for chest muscle strengthening, facilitating to rhythmicity of breathing with longer exhaling.
«Take to shoulders». P.p. – stride position, hands to shoulders, elbows sideward. Throw the crossed arms around the shoulders during the hash inhaling. Relax arms during exhaling.	32 raps	Move arms in one direction move. Don't overstrain strength.	Development of compensatory mechanisms which secure the improvement of lung ventilation.
«Shooter». P.p. – one leg on the chair, arms at hips. Half bent – inhale, two bouncy bents forward – exhale.	8 raps	Do in right leg position, and then do again in left leg position.	Improvement of lung ventilation and respiratory metabolism by strengthening of muscles of respiration.
«Jumping». P.p. – sitting on a fitball. Bouncy jumping with active arm work.	30 sec. – 1 min.	Don't straighten legs.	Development of aerobic tolerance, activation of lung ventilation.
«Eights». P.p. – stride position, half bent forward. Full inhale and a breath hold. Count to eight and exhale.	32 raps	Keep the body relaxed.	Activation of body tissue exchange and oxidation-reduction process.
«Fitball». P.p. – lie on a ball face down, feet fixed, hands on the nape. Raise the upper body and fix – inhale; p.p. – exhale.	10–15 raps	Don't throw head back; raise the upper body higher than horizontal line.	Exercise for back muscle strengthening.
«Abduction». P.p. – lie on back on a stepper (bench). Move arms with dumbbells sideward – inhale, p.p. – exhale.	10–15 raps	Elbows sideward, but not lower than horizontal line.	Exercise for chest muscle strengthening, facilitating to rhythmicity of breathing with longer exhaling.

doctors defined the main characteristics of post-COVID rehabilitation according to the main six categories of people (with disorders of cardiovascular, respiratory and digestive systems; locomotor apparatus disorders).

Early in the course of bringing back to physical training after the light form of coronavirus disease it is important to stick to a rule according to which the portion of physical exercises in the first week after the recovery is to be reduced to 50 %; in the next three weeks it is to be equal to 70 %, 80 % and 90 % of physical training level before the disease. At the same time it is important to monitor the body responses to any changes and modify the basic plan in appropriate cases.

Developed, implemented and experimentally proved the effectiveness of health and fitness program «Fitness Energy» as a complex of selective breathing and aerobic exercises which are done in a particular order and allow acting deliberately on human body of people who suffered from COVID-19 to secure the maximum health-improvement effect. «Fitness Energy» is the organized system of exercise for people who suffered from COVID-19 and need fast working capacity level increase. The program «Fitness Energy» doesn't require the preliminary preparation (essential physical activity experience) and is recommended for every person regardless of age, sex and physical condition. The exercises of the program improve the work of cardiovascular and respiratory systems (activation of expectoration, de-cough, strengthening of muscles activated in breathing), internal organs, strengthen muscles and ligaments, and have a general toning effect.

Program means include the respiratory exercises in a standing posture; exercises in a standing posture and on the ground with special equipment (running machine, balls, rings, rubber expanders, yoga wheels, yoga mats, etc.). The program is based on O. Strelnikova's gymnastics which exercises include short and fast nose-blow. As a result, the body is enriched with oxygen, the blood composition is normalized, and the heath rate is regained. It is important for people who suffered from COVID-19, because the disease affects lung ventilation. The exercises with equipment improve general body condition and increase working capacity level. The program «Fitness Energy» is unique in that the exercises are done at accessible studio and every session differs in its content [8–10].

Training technology: a session is delivered 5 times a week, 50–55 minutes each; the group of 6 people is led by an instructor. The exercises are done using the method of circuit training – 4 circuits with 7 exercises in each. The instructor runs a warmup, explains a breathing technique and shows how to do the exercises with equipment (Table 2).

Health improvement after the disease requires exercises aimed at chest muscles strengthening, because chest muscles participate in respiratory movements. These exercises are done in a standing, sitting or lying position with different equipment: dumbbells, rings, balls of different sizes. The positive effects have the body crunching and turning exercises which are done in frontal and sagittal area, or lying on back. While doing these exercises it is important

Table 3. Benchmarking analysis of status of people after COVID-19 disease in control (n=26) and experimental (n=26) groups before and after the experiment

Indices, tests, measurement units	G1 → G2			EG1 → EG2					
	G1	G2	Increment	R	EG1	EG2	Increment	R	EG2 → EG2
		M ± m				M ± m			M ± m
Ruffier-Dickson Index (c. u.)	12,0±0,9	10,8±0,81	3,8 %	>0,05	11,3±0,8	4,95±0,63	32,8%	>0,05	29 %
Stange test (sec)	27,6±1,26	31,2±1,9	9,0 %	>0,05	26,5±1,2	42,4±3,1	23,9 %	>0,05	14,9 %
Gendha test (sec)	17,0±1,8	20,7±2,1	9,1 %	>0,05	16,4±2,9	26,1±2,9	19,4 %	>0,05	10,3 %
Step test (c. u.)	62,6±1,46	65,4±1,67	4,3 %	>0,05	63,2±1,7	82,9±4,7	24,1 %	>0,05	19,8 %
PWC 170 absolute / relative (kgm/min)	580±58,7/17,2±1,06	707±74,7/17,8±1,2	14,9 %	>0,05	566±55,8/17,4±1,26	810±79,8/21,9±1,9	28,7 %	>0,05	13,8 %
Mean increment			8,22 %				25,78 %		17,56 %

to pay attention to the breathing technique. An exhale is done while crunching; an inhale is done in preparatory position. Every program is to contain back strengthening and stretching exercises [11–13].

Health-improving exercises are not recommended to do with rising temperature or significant toxic syndrome. They are also contraindicated with severe respiratory distress, status asthmaticus, pleural empyema, purulent pulmonary effusion, and pulmonary tuberculosis with necrosis [14–15].

RESULTS

After 6-months-long experiment aimed at the implementation of graduated, systematic and complex health and fitness program «Fitness Energy» managed by a training specialist in experimental group, and natural body recovery in control one the results were fixed. The positive changes in health status of post-COVID people were fixed both in experimental group (25,78 %) and in control one (8,22 %). In particular, the positive changes were fixed in respiratory system status which is reflected in indices of repeated Stange (CG2 – 9,0 %, EG2 – 23,9 %) and Gencha tests (CG2 – 9,1 %, EG2 – 19,4 %). We also fixed the improvement of cardiovascular system work which is reflected in Ruffier-Dickson Index (CG2 – 3,8 %, EG2 – 32,8 %); working capacity level increase which is reflected in indices of step test (CG2 – 4,3 %, EG2 – 24,1 %) and PWC 170 (CG2 – 14,9 %, EG2 – 28,7 %) (Table 3).

DISCUSSION

Criterion analysis of cardiovascular and respiratory systems status and general working capacity of people who suffered from COVID-19 before the experiment gives grounds for asserting that indicated indices conform to low-medium and medium levels. It is caused by the individual reduced cardiovascular system functioning (74 % of respondents complained of angor pectoris and arrhythmia caused by virus disease and a long-term bed regime), respiratory function (89 % of post-COVID patients had a short breath, felt air shortage and had a dry reflex cough), and general working capacity (100 % of people included virus (chronic) fatigue syndrome and muscle dysfunction (muscle tone reduction) to the consequences of coronavirus; 100 % of people suffered from insomnia and headaches) [6].

The difference in physical work capacity is noted, in a greater degree, in experimental group (28,7 %) than in

control one (14,9 %). This fact is explained by the program of experimental group which involved aerobic exercising with increase in respiratory uptake that along with regeneration of respiratory system promoted improvement of cardiorespiratory (general) tolerance associated with physical working capacity. The significant working capacity improvement in control group is explained by the fact that after the disease most of people got back to everyday life, had recreative activity outdoors (59 % – active games with children, 46 % – dog walking, 23 % – independent exercising in the sports grounds, 12 % – bicycling, 10 % – hiking in the countryside) [10].

Positive changes are fixed in experimental group as a result of implementation of the program which included gradual performing of breathing exercises alternating with conditioning ones, and activated the recovery process after the virus disease. Less significant changes are fixed in control group which is explained by natural recovery potential, high diet and independent physical training.

CONCLUSIONS

The analysis of special literary sources gives grounds for asserting that the main COVID-19 symptoms include body temperature rise (87,9 %), dry cough (67,7 %), weakness (38,1 %), respiratory difficulty (18,6 %) and muscle ache (14,8 %). The whole host of functional systems disorders of different degrees of severity is fixed. The content of recovery programs is to be in line with disease development. The training process is started with light physical exercises, good rest, step-by-step dose escalation, and including of breathing exercises. The research showed that the program «Fitness Energy» is a complex of special breathing and aerobic exercises which are done in specific sequence and targeted body treatment, and secures getting of the highest possible health-improvement effect. The main program results include recovery of cardiovascular (CG2 – 3,8 %, EG2 – 32,8 %) and respiratory (CG2 – 9 %, EG2 – 21,6 %) systems, performance incoordination (CG2 – 9,6 %, EG2 – 26,4 %). Experimental research verified the research hypothesis, in particular the overall result upon indications of functional status of people in experimental group is 17,5 % higher than in control one. This indicates the effectiveness of rehabilitation patients, in particular, improves the cardiovascular and respiratory systems, strengthens the muscles involved in respiration, increases the overall tone and efficiency of the body.

References

1. Scudellari M. The sprint to solve coronavirus protein structures – and disarm them with drugs. *Nature*. 2020;581(7808):252-255. doi: 10.1038/d41586-020-01444-z.
2. Mizutani T. Signal transduction in SARS-CoV-infected cells. *Ann. NY Acad. Sci.* 2007;1102:86-95. doi: 10.1196/annals.1408.006.
3. Golubovskaya OA, Bezrodnaya AV, Kondratyuk LA et al. Coronavirus disease of 2019 (COVID-19): characteristics, diagnosis, treatment and preventive services. *Clinical infectology and parasitology*. 2020;9(1):6-16.
4. Vysochyna IL, Nikolaenko-Kamyshova TP, Biesiedin OM. Postcovid syndrome: regarding the risks of developing thrombotic complications in patients with ischemic limb lesions (clinical cases). *Medicni Perspektivi*. 2021;26(3):205-211.
5. Szczegieliński J, Bogacz K, Majorczyk E et al. Post-COVID-19 rehabilitation – a Polish pilot program. *Med Pr*. 2021;72(5):611-616. doi: 10.13075/mp.5893.01122.

6. Coudeyre E, Cormier C, Costes F et al. Réadaptation musculaire après infection à COVID-19 [Muscular rehabilitation post COVID-19 infection]. *Revue du Rhumatisme Monographies*. 2021;88(3):251–254. doi: 10.1016/j.monrhu.2021.03.002. (in French).
7. Serhienko LP. Sportyvna metrolohiia: teoriia i praktychni aspekty [Sporting metrology: theory and practical aspects]. Kiev: KNT. 2010, p.776. (in Ukrainian).
8. Kornosenko OK. Ozdorovitel'nyj fitness: teoriia i praktychni aspekty [Health-improving fitness: theory and practical aspects]. Poltava: Simon. 2020, p.273. (in Ukrainian).
9. Kornosenko O, Khomenko P, Taranenko I et al. Professional competencies as a component of professional training of a fitness trainer-teacher in higher education institutions. *Journal for Educators, Teachers and Trainers*. 2021;12(1):72-81. doi: 10.47750/jett.2021.12.01.010.
10. Kornosenko O, Denysovs T, Danysko O et al. System of Preparation of Future Fitness Coaches' for Health-Improving Activity in the Conditions of Rehabilitation Establishments. *International Journal of Applied Exercise Physiology*. 2020;9(8):33-41.
11. Otravenko O, Shkola O, Shynkarova O et al. Leisure and recreational activities of student youth in the context of health-preservation. *Journal for Educators, Teachers and Trainers*. 2021;12(3):146-154.
12. Shkola O, Andriushchenko T, Zhamardiy V et al. Rope skipping as a means of increasing students' physical activity. *Journal for Educators, Teachers and Trainers*. 2022;13(1):301-309. doi: 10.47750/jett.2022.13.01.031.
13. Shkola O, Zhamardiy V, Kyzim P et al. Fitness exercises as a means of motivation for physical education classes for high school students. *Journal for Educators, Teachers and Trainers*. 2022;13(2):243-251. doi: 10.47750/jett.2022.13.02.023.
14. Zhamardiy VO, Donchenko VI, Yemets AV, Skrinnik YO. Physical Development by Means of Fitness Technologies as One of General Aspects of Student's Health. *Wiad Lek*. 2019;72(5):1074-1078.
15. Zhamardiy V, Shkola O, Tolchieva H, Saienko V. Fitness Technologies in the System of Physical Qualities Development by Young Students. *Journal of Physical Education and Sport*. 2020;20(1):142-149. doi:10.7752/jpes.2020.01019.

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THE NATURE OF MOTIVATION FOR A HEALTHY LIFESTYLE IN CHILDREN OF DIFFERENT AGES

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ABSTRACT

Aim: To study the types of motives for a healthy lifestyle (HLS) in children of different ages.

Materials and Methods: The research involved 150 children. The children were interviewed using the questionnaire developed by the authors, which contained 15 questions, using Google Forms. The survey was anonymous without any references to the authors made in the article. Methods: bibliosemantic, systematic analysis and generalization, medical and sociological, and statistical data processing.

Results: The psychosocial stages of children's development have been revealed and the motivation of children of different ages for a HLS has been characterized. It has been found that 72.0 % of the surveyed children have sufficient knowledge about the essence of a HLS, but most of them do not use this knowledge, only one-third regularly adhere to a HLS. Among the dominant motives for a HLS, children named the desire not to get sick (36.0 %), to be a physically healthy and spiritually rich individual (16.0%), to promote health and improve posture (12.0 %), to have a good physique (12.0 %).

Conclusions: The availability of knowledge but the lack of appropriate skills and parental control lead to children's neglect of a HLS and, consequently, their health. In the process of forming children's HLS motivations, it is necessary to intensify the work of parents, taking into account the individual and age characteristics and needs of their children, and taking into account the priority sources of information about maintaining their health.

KEY WORDS: healthy lifestyle, health, motivation, children

INTRODUCTION

In today's society, every child is systematically exposed to countless examples of human lifestyles. This diversity is not always a model for them, which results in chaos in their ideas about a healthy lifestyle (HLS) and destroys the examples that have already been formed [1, 2]. In addition, today there is a negative trend characterized by a decline in the health of the younger generation, which causes an urgent need to form the right ideas about a HLS in children and requires the search for new ways in education and upbringing [3-5].

WHO identifies the following negative factors that affect the health of a modern person: psycho-emotional overload; insufficient motor activity; irrational diet and related overweight (obesity); bad habits (smoking, alcohol abuse, drug addiction). According to scientists [6-8], the health of the younger generation depends not only on these factors but also on knowledge about the principles of a HLS and conscious motivation to follow them. Such motivation is formed primarily in the family.

AIM

The aim is to study the types of motives for a healthy lifestyle (HLS) in children of different ages. Objectives: 1) to reveal the psychosocial stages of children's development; 2) to characterize the motivation of children of different ages for a HLS; 3) to study the state of children's compliance with a HLS.

MATERIALS AND METHODS

The research was conducted in 2020-2022 at Zhytomyr Medical Institute of Zhytomyr Regional Council and Zhytomyr Ivan Franko State University. Methods: bibliosemantic, which included an analytical review of sources of scientific information on the research topic (18 sources from the scientometric databases Web of Sciences, Index Copernicus, Scopus, PubMed, and others were investigated); system-oriented analysis and logical generalization was used to formulate conclusions based on the results of the research; medical and sociological aimed at questioning parents; statistical processing method was utilized to process the experimental data obtained in the course of the research.

The research involved 150 children of different ages (10-12 years old (junior adolescence) – 62.0 % (93 people); 13-14 years old (senior adolescence) – 11.3 % (17 people); 14-18 years old (youth) – 26.7 % (40 people). The medical and sociological study among children was conducted to assess their compliance with the rules of a HLS. The survey was conducted using a specially designed questionnaire using Google Forms. The design of the questionnaire was typical and contained the structural components: addressing the respondent, obtaining informed consent to participate in the survey, and actual blocks with targeted questions (15 questions in total). The questionnaire was anonymous without any references to the authors of the article in the answers. The results were used for scientific purposes only. Questionnaire was assessed by the experts in this field (2 professors and 4 associate professors) and was approved by the Academic Council of Zhytomyr Ivan Franko State University (Protocol No. 14 dated 26.08.2020). Consent to voluntary participation in the survey was obtained from all the respondents involved in the study. This research followed the regulations of the World Medical Association Declaration of Helsinki – ethical principles for medical research involving human subjects.

RESULTS

Modern research [9-11] allows us to identify several psychosocial stages of the younger generation's development:

1. Infancy (from birth to the end of the 1st year). Thanks to maternal care, the foundations of a healthy personality are laid during this period, which manifest themselves in the form of a general sense of trust, confidence in safety, and inner certainty. The child begins to trust society based on the degree of trust in the mother. Feelings of distrust, fear, and suspicion appear when the mother is unreliable and pushes the child away. In this case, the child's HLS is aimed at maintaining and promoting his or her health. The difference between this period and other age groups is that the child has no motivation for his or her health.
2. Early childhood (from 1 to 3 years). At this age, the child begins to act independently (stand, walk, wash, dress, eat). A child at this stage is characterized by a formula: "I am myself" and "I am what I can do," which contributes to the child's autonomy. In the case of constant hyper care or, conversely, when parents expect too much from the child, which goes beyond his or her capabilities, he or she develops doubts and self-doubt, and weak willpower. The differences from other age groups are that a child eats healthy food, sleeps the amount of time he or she needs, and plays with his or her favorite toys, not realizing that these are components of his or her HLS. The child acts following his or her physiology, and parents should direct this process to strengthen his or her health. The main motives of children's HLS at this age, which should be formed by parents, are the motives of self-preservation, self-development, and the desire to gain the approval of others ("I can do it myself").
3. Age of play (from 3 to 6 years). This period is characterized by a conflict between initiative and guilt. Children show interest in various activities, trying new things, interacting with peers, and easily fall under the influence of teaching and upbringing. This is the age with the slogan: "I am what I will be". Encouraging a child's endeavors helps to foster initiative, expand the boundaries of independence, and develop creativity. Nevertheless, because of excessive control and restriction of activities, children develop a strong sense of guilt. Children affected by this feeling are passive, constrained, and in the future will not be capable of productive work. During this period, children get to know their peers, want to be like their friends, and have nice clothes, toys, and the opportunity to run and play with everyone. Therefore, when motivating their children to adopt a HLS, parents often appeal to extrinsic motives that are "important" to them ("I'll buy you this toy if you do exercises and follow the rules of hygiene on your own"). We believe that on their children's way to a HLS, parents should develop identification motives (the best examples of a HLS of parents or other family members, peers of the child), the desire to gain the approval of others ("I am liked" when I wash my hands, do exercises), health-promoting motives (awareness of the importance of wearing a protective mask in public places).
4. Age of adolescence (from 6 to 12 years of age – junior adolescence and from 13 to 14 years of age – senior adolescence) is the first period when a child leaves the family and begins systematic education. The child's identity is now expressed as follows: "I am what I have learned". While studying at school, children learn the rules of conscious discipline and active participation in their own social life. The danger of this period is the presence of feelings of inferiority or incompetence, and doubts about their abilities or status among their peers. Children of this age strive to be good students, do physical exercises, play games with other children, and be liked by the opposite sex. The main principle of parents' motivation for their children's HLS is the motive of self-improvement ("You need to be healthy to continue playing football"). Other motives for a HLS include the following: identification motive (with parents or other family members, teachers, peers), submission to ethno cultural requirements, health-preserving motives (when a child likes the sport he or she is involved in; he or she wants to stay healthy), achievement motives (success in sports), the desire to gain the approval of others (teachers, peers, parents), prosocial motives (awareness of the importance of personal hygiene for public health in the context of the coronavirus pandemic), affiliation motives (maintaining personal hygiene as a condition for establishing and maintaining contacts with peers), and enjoyment of health.
5. Youth (15-20 years) is the most important period in a person's psychosocial development (he or she

is no longer a child, but not yet an adult). A young person faces new social roles and related requirements. He or she evaluates the world and his or her attitude towards it, and spontaneously searches for new answers to important questions: "Who am I?", "Who do I want to become?". Teenagers experience a piercing sense of uselessness, mental disorder, and aimlessness, and sometimes they turn to a "negative" identity and deviant (abnormal) behavior. Identity crisis (role confusion) leads to an inability to choose a profession or continue education. An important task for parents during this period is to help their children make their own choice in favor of a HLS and adherence to its principles. However, parents in this period cannot radically influence their adult children's adherence to a HLS if they are not an authority for them. The motives for a HLS at this stage of a young person's life can be different, namely: "to be healthy in order to" continue education, to ensure his or her material well-being, to be competitive in the labor market, to be liked by the opposite sex, to create a healthy family, etc. In this context, to influence their adult child's involvement in a HLS, parents can promote the formation of motives for self-improvement, self-actualization and achievement ("having bad habits, you will not be able to get a prestigious job"), prosocial motives ("the company you want to work for is used to doing sports"), motives of power ("a manager should be a model for his or her subordinates in everything, be healthy physically and psychologically, and for this purpose it is necessary to observe optimal work and rest regime, to do sports, to harden"), motives of identification (with successful people), directly health-preserving motives (regarding favorite sports; control over one's health), affiliation motives ("to establish and maintain positive relationships with people and create a healthy family, one needs to be healthy, and this is possible only if one adheres to a HLS"), achievement of maximum comfort ("you will feel physically and psychologically comfortable if you are healthy"), and sexual fulfillment ("your health will give you the opportunity to create harmonious sexual relationships").

The motives that motivate a child to adopt a HLS directly depend on his or her needs. A. Maslow [12] identified five levels of personality needs: physiological, safety, social (belonging to a team, society), recognition (respect), and self-actualization (self-expression). The relationship between the types of needs in human life, the types of needs in the context of HLS principles, and motives as incentives for the realization of the needs of children of different ages are shown in Table 1.

Figure 1 shows the results that demonstrate children's vision of the essence of a HLS. The results show that the majority of children surveyed (72.0 %) understand the meaning of the concept of "a HLS".

The results of children's responses about their adherence to a HLS show that 42.0 % partially lead a HLS; 32.0%

regularly follow a HLS; 26.0 % do not lead a HLS at all. Even though the overwhelming majority of respondents (72.0 %) understand the essence of a HLS, only 32.0 % adhere to its principles. This difference in knowledge and its practical implementation can be explained by insufficient awareness of the value of health and the lack of parental motivation for a HLS.

The dominant motivation for adherence to a HLS for 36.0 % of the surveyed children is the desire not to get sick; 16.0 % – to be physically healthy and spiritually rich; 12.0 % – to promote health, 12.0 % – to improve posture, to have a good physique; 10.0 % – to improve their own body; 8.0 % – to be liked by peers; 4.0 % – to develop physical abilities; 2.0 % – to assert themselves.

The survey also found that only 12.0 % of children follow the correct daily routine, 36.0 % follow it from time to time, 14.0 % do not follow the daily routine at all, and 38.0 % said they did not care. Children spend most of the day outdoors: 1-3 hours – 38.0 %; from 3 to 5 hours – 8.0 %; rarely outdoors – 54.0 %. As you know, children under 11 should spend 2-2.5 hours outdoors, and older children should spend 1-1.5 hours. However, more than half of the surveyed children do not prefer outdoor activities, as they mostly spend time in a virtual environment (social networks, computer games). It was found that only 12.0 % of children spend enough time sleeping, 42.0 % do not sleep enough, and 46.0 % do not know how long their sleep should last. This indicates that most respondents have problems with the quality and duration of sleep. At the same time, the vast majority of children go to bed after 23:00 – 63.3 %, 26.7 % – at 22:00, 10.0 % have sleep disorders, i. e. are prone to insomnia. It was found that just 40.0 % of children brush their teeth regularly in the morning, while 30.0 % do it sometimes or do not brush their teeth at all. Only 24.0 % of respondents systematically do morning exercises, 38.0 % do it occasionally, and 38.0 % do not do morning exercises at all. In this case, parents should teach their children to be persistent and disciplined in daily morning exercises from an early age, emphasizing its health benefits. The study of children's involvement in sports showed that 28.0 % of children systematically attend sports sections, clubs, and unions; 36.0 % – periodically; 18.0 % – lead a sedentary lifestyle and do not play sports; the remaining 18.0 % – are unable to play sports due to contraindications to physical activities.

Regarding children's compliance with a rational diet, it was found that 42.0 % of children do not always eat regularly and in a balanced manner, 26.0 % do not follow a rational diet, and only 32.0 % systematically adhere to the correct eating behavior. The benefits of water are undeniable, but its insufficiency leads to dehydration and disrupts the functioning of body systems. It was found that 28.0 % drank enough drinking water per day, 30.0 % – not enough, and 42.0 % failed to provide a clear answer. Answers to the question about the sources of information about a HLS were distributed as follows: most often respondents receive information about a HLS from parents and relatives (28.0 %), from the media (Internet, social networks, etc.),

Table 1. Nature of motivation of children of different ages for a HLS

Types of needs according to A. Maslow	Types of needs in the context of a HLS	Motives for a HLS
Physiological	Adequate and rational nutrition, healthy sleep	Early childhood
Safety	Personal hygiene, adequate and rational nutrition, healthy sleep, active recreation, sports, outdoor walks, hardening, quitting bad habits, optimal work and rest schedule	Extrinsic motives: self-development (“I can do it myself” – brushing teeth, washing hands, washing, eating, exercising, getting dressed for a walk, going to bed, etc.), identification (being like parents in their adherence to HLS elements), obtaining parental approval, self-preservation (being careful not to harm your health)
Social (belonging to a team, society)	Personal hygiene, active recreation, sports, quitting bad habits, optimal work and rest schedule	3-6 years old children
		Intrinsic motives: directly health-preserving (e. g., eating healthy food; sleeping during the day to rest and play again; washing hands after walking and before eating to avoid getting sick; wearing a protective mask in public places; doing morning exercises, participating in entertainment programs, riding a bike, scooter, swimming, rubbing down with cool water, going to the pool, etc.) Extrinsic motives: identification (to play sports and harden up like parents or other family members, peers) and the desire to gain the approval of others (to get a toy by doing morning exercises), and to comply with ethno cultural requirements.
Recognition, self-actualization	Exercise, hardening, quitting bad habits, optimal work and rest schedule	Adolescence
		Intrinsic motives: directly health-preserving (the child likes the sport he or she is involved in; he or she eats healthy food with pleasure, and knows how to differentiate it from junk food; the child sleeps the number of hours necessary for his or her age; he or she does morning exercises without being forced; gets hardened; attends sports clubs, unions, associations, etc., hiking trips, recreation camps; adjusts his or her health activities (contrast shower, sunbathing, etc.); alternates mental and physical activity (i. e., strengthens occupational health skills to avoid overwork); has a positive mindset; generally takes care of his or her health and does not want to get sick). Extrinsic motives: identification motive (he or she adheres to the principles of a HLS, like parents or other family members, favorite teachers, peers), achievement motives (tries to achieve success in sports, have a good body type), desire to get the approval of others (teachers, peers, parents), prosocial motives (realizes the importance of personal hygiene for public health, especially in the context of the coronavirus pandemic), affiliation motives (supports personal hygiene as a condition for establishing and maintaining contacts with peers; tries to be healthy and beautiful to be liked by his or her peers, including the opposite sex; strives to have a healthy family), the motive of enjoying health.
		Youthful age
		Intrinsic motives: directly health-preserving, self-improvement, and achievement of maximum comfort (he or she wants to be healthy and beautiful, have good and healthy skin condition, body weight that meets physiological norms, prevents overeating and obesity, observes hygiene of clothes, shoes and home, sexual culture; engages in favorite sports and active leisure activities (football, tennis, skiing); consciously gives up bad habits; learns to manage stress; constantly monitors his or her health, including mental health; tries to become confident and emotionally happy). Extrinsic motives: motives of self-actualization (including sexual) and achievement (taking care of one's health, quitting bad habits to get a prestigious job, creating material well-being, establishing sexual relationships); prosocial motives (he or she engages in sports and other active forms of recreation, as is customary in the environment – class, college, higher education institution, etc.), power motives (wants to stand out among members of the class, group, work team by being unique to get opportunities to lead this team); identification motive (wants to be like successful people), affiliation motive (tries to be healthy to establish and maintain positive relationships with group members, management, and create a healthy family).

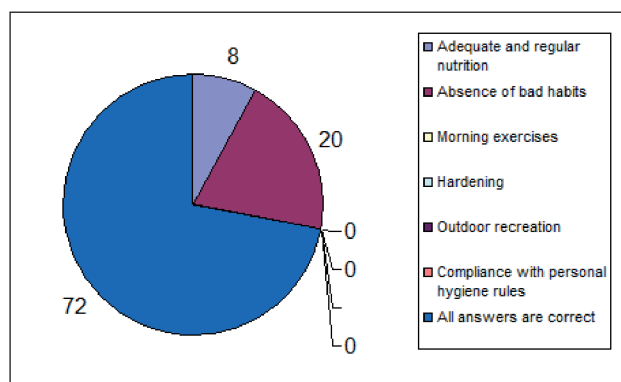


Fig 1. Children's understanding of the concept of a HLS

and from peers and friends (24.0 % each). The survey results also show that educational institutions do not devote enough time to covering the issue of a HLS.

DISCUSSION

A person's focus on a HLS is a rather complex and controversial process that depends on the peculiarities of state development, public opinion, environmental situation, educational process, and family upbringing orientation [13, 14]. Given this, from early childhood, it is necessary to create an environment around children that would contain the necessary knowledge, habits, skills, and abilities regarding a HLS.

Forming a culture of a HLS is a necessary component of primary prevention to improve public health by changing lifestyles, promoting health, and using knowledge to counteract addictions, physical inactivity, etc [15, 16]. The WHO provides several interpretations of the definition

of a "healthy lifestyle": human behavior that ensures the preservation and promotion of health; an individual system of habits necessary to maintain a certain level of life-sustaining activities related to solving personal and professional tasks [17, 18]. We believe that a HLS is the only existing way to restore, maintain and promote the health of the population. Therefore, the formation of this lifestyle in the life of the population is the most important social task on a national scale.

CONCLUSIONS

The psychosocial stages of children's development have been revealed and the motivation of children of different ages for a HLS has been characterized. It has been found that 72.0 % of the surveyed children have sufficient knowledge about the essence of a HLS. Of course, the education of children is positive, but most of them do not use this knowledge: only one-third regularly adheres to a HLS; 12.0 % – have the correct daily routine; 40.0 % – brush their teeth regularly; 24.0 % – systematically do morning exercises; 28.0 % – attend sports sections, clubs; 32.0 % – adhere to proper eating behavior. Among the dominant motives for a HLS, children named the following: the desire not to get sick (36.0 %), to be physically healthy and spiritually rich (16.0 %), to promote health and improve posture, and to have a good physique (12.0 % each). Thus, the availability of knowledge, but the lack of appropriate skills and parental control, leads to children's neglect of a HLS, and, accordingly, their health.

Prospects for further research aim to study the motivation for a HLS among subjects of the educational process in schools (teachers and high schoolers) and higher educational institutions (instructors and students).

References

1. Stonerock GL, Blumenthal JA. Role of Counseling to Promote Adherence in Healthy Lifestyle Medicine: Strategies to Improve Exercise Adherence and Enhance Physical Activity. *Prog Cardiovasc Dis.* 2017;59(5):455-462. doi:10.1016/j.pcad.2016.09.003.
2. Zaman R, Hankir A, Jemni M. Lifestyle Factors and Mental Health. *Psychiatr Danub.* 2019;31(3):217-220.
3. Griban G, Moskalenko N, Adyrkhaiev S et al. Dependence of students' health on the organization of their motor activity in higher educational institutions. *Acta Balneol.* 2022; 5 (171): 445-450. doi: 10.36740/ABAL202205112.
4. Arefiev V, Tymoshenko O, Malechko T et al. Methodology of differentiation of health-improving classes in physical education for primary school students. *Int J Appl Exer Physiol.* 2020; 9(7): 134-143.
5. Pengpid S, Peltzer K. Sedentary behaviour, physical activity and life satisfaction, happiness and perceived health status in university students from 24 countries. *Int J Environ Res Public Health.* 2019; 16(12):2084. doi: 10.3390/ijerph16122084.
6. Prysiazniuk S, Oleniev D, Tiazhyna A et al. Formation of health preserving competence of students of higher educational institutions of information technologies specialties. *Inter J Appl Exer Physiol.* 2019; 8(3.1): 263-271.
7. Griban G, Prontenko K, Yavorska T et al. Non-traditional means of physical training in middle school physical education classes. *Inter J Appl Exer Physiol.* 2019; 8(3.1): 207-214.
8. Griban G, Filatova O, Bosenko A et al. Water in students' life and its impact on their health. *Acta Balneol.* 2021; 2 (164): 99-104. doi: 10.36740/ABAL202102104.
9. Griban G, Dovgan N, Tamozhanska G et al. State of physical fitness of the students of Ukrainian higher educational institutions. *Inter J Appl Exer Physiol.* 2020; 9(5): 16-26.
10. Mukdad L, Shapiro NL. Establishing Healthy Lifestyle Choices Early: How to Counsel Children and Their Parents. *Otolaryngol Clin North Am.* 2022;55(5):1111-1124. doi:10.1016/j.otc.2022.06.013.
11. Pantiu TI, Pantiu MP, Kvas OV et al. Healthy lifestyle principles formation of children aged 6-7. *Wiad Lek.* 2021;74(10):2477-2481.
12. Taormina RJ, Gao JH. Maslow and the motivation hierarchy: measuring satisfaction of the needs. *Am J Psychol.* 2013;126(2):155-177. doi:10.5406/amerjpsyc.126.2.0155.
13. Marconcin P, Matos MG, Ihle A et al. Trends of Healthy Lifestyles Among Adolescents: An Analysis of More Than Half a Million Participants From 32 Countries Between 2006 and 2014. *Front Pediatr.* 2021;9:645074. doi:10.3389/fped.2021.645074.

14. Grey EB, Atkinson L, Chater A et al. A systematic review of the evidence on the effect of parental communication about health and health behaviours on children's health and wellbeing. *Prev Med.* 2022;159:107043. doi:10.1016/j.ypmed.2022.107043.
 15. Münzel T, Münzel H, Geipel P et al. Educating Children for a Healthy Lifestyle. *Eur Heart J.* 2019;40(25):2000-2003. doi:10.1093/eurheartj/ehz419.
 16. Skouteris H, Hill B, McCabe M et al. A parent-based intervention to promote healthy eating and active behaviours in pre-school children: evaluation of the MEND 2-4 randomized controlled trial. *Pediatr Obes.* 2016;11(1):4-10. doi:10.1111/ijpo.12011.
 17. Maximova K, Ambler KA, Rudko JN et al. Ready, set, go! Motivation and lifestyle habits in parents of children referred for obesity management. *Pediatr Obes.* 2015;10(5):353-360. doi:10.1111/ijpo.272.
 18. Richards D, Caldwell PH, Go H. Impact of social media on the health of children and young people. *J Paediatr Child Health.* 2015;51(12):1152-1157. doi:10.1111/jpc.13023.
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HAY THERAPY (*FENUM*) IN PHYTOBALNEOTHERAPY IN SEBASTIAN KNEIPP'S METHOD WITH RESPECT TO THE DIVERSITY OF *CNIDION DUBII* MEADOWS IN THE VISTULA VALLEY IN POLAND (CENTRAL EUROPE)

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ABSTRACT

Aim: Estimation of usefulness and efficiency of hay therapy (*fenum*) in phytobalneotherapy in Sebastian Kneipp's method with respect to the diversity of grassland communities from the *Cnidion dubii* alliance in the Vistula valley in Poland.

Materials and Methods: In this study a grassland community was studied following the methods of the Zurich-Montpellier School of Phytosociology. Kneipp's thermotherapy treatments, include: warm baths, half-baths, sitting baths and partial baths as well as compresses made of hay bags. Sebastian Kneipp traditionally, used only hay bags for hay treatments.

Results: In the Vistula valley in Poland, grassland communities of the *Cnidion dubii* alliance are a habitat with more than nine dominant medicinal species which may be used in balneotherapy and other health resort treatments: *Allium angulosum*, *Achillea millefolium*, *Centaurea jacea*, *Lychnis flos-cuculi*, *Lysimachia vulgaris*, *Menyanthes trifoliata*, *Potentilla erecta*, *Ranunculus acris*, *Rumex acetosa*, *Sanguisorba officinalis*, *Succisa pratensis*.

Conclusions: Hay from the *Cnidion dubii* meadows in the Vistula valley in Poland has antibacterial, anti-inflammatory, protozoocidal, antifungal, antiviral, congestive, antiseptic, anti-rheumatic, antispasmodic, and antioxidative properties, and is soothing to inflammations of the skin. Indications: Bechterew's disease, rheumatoid arthritis in the non-acute phase, arthrosis of the joints of the upper and lower limbs, pain syndromes of the cervical and lumbar spine in the non-acute phase, neuralgia, enthesopathies of muscles and tendons, states of increased tone of the skeletal muscles and smooth internal organs, dysmenorrhea, tendency to boils and blemishes, leg ulcers, skin inflammations, atopic skin lesions, skin care, as well as a treatment accelerating the body's regeneration processes in biological regeneration and professional sports.

KEY WORDS: hay therapy, *fenum*, phytobalneotherapy, health resorts, Sebastian Kneipp, grasslands, *Cnidion dubii*, meadows, Vistula valley, Poland, Central Europe

INTRODUCTION

Health resorts are undergoing considerable changes. Traditional forms of treatment, focused on the pathogenesis, are enriched by methods based on the salutogenic approach, for example Sebastian Kneipp method [1] which is very popular. The use of hay in therapy is a tradition in the Alpine and subalpine regions: in Germany, Austria, Switzerland and the German-speaking part of Italy. In Germany, Austria and Switzerland, hay therapy is used as part of the Sebastian Kneipp method, mainly in the form of warm compresses (hay bags) and baths [2-9]. In Italy, warm baths in fermented hay are used to treat degenerative diseases, rheumatism and fibromyalgia [10-14]. This system is becoming increasingly important especially in prevention activities, therefore in other countries (e.g., in Poland) it is emphasized the possibility of usage of the Kneipp method in the prevention of lifestyle diseases. A new role for health resorts is mainly related to the physio-prevention as well as the enlargement

of the treatment offer and introduction of new and standardized forms of therapy [15-18]. One example would be phytobalneotherapeutic treatment with hay (*fenum*) used as supplementation in baths, compresses and wrappings [11]. Despite the common usage of this method in health resorts, there are not many academic publications describing this subject. The aim of this work is to prompt further clinical research on hay therapy usage showing dependences on the original grassland community with specific medicinal plant species included in its composition. Generally, hay of some Central European grasslands (phytosociological alliances) is appropriate for balneotherapy and spa resort treatment, where knowledge of these grasslands is helpful in the usage of these hays in the prevention as well as therapy of many diseases [16]. Hay compresses and baths are currently used in spa treatment for neuralgia and spinal pain, non-inflammatory conditions of skeletal muscle tension and smooth internal organs, menstrual disorders, rheumatic diseases, spinal

joint degeneration, acute and chronic bronchitis, as well as a treatment accelerating regeneration processes [2, 5, 19]. The Sebastian Kneipp method (1821-1897) is a complex therapy used in balneotherapy and in a spa treatment and as a prevention of lifestyle diseases. It is based on the so-called five pillars: hydrotherapy, physiotherapy, dietetics, phytotherapy and a life ordering treatment, and fully meets the requirements of a modern civilization threats [3, 19, 20].

A comprehensive, standardized Kneipp method proposes a healthy lifestyle, leads to the reduction of bad habits and shapes a new, healthy, one. It restores, psychophysical balance of the body by: activating reserves of stamina, training defense mechanisms, improving autonomic functions, regulating the functioning of internal organs and ordering basic bodily functions such as sleep, metabolism, respiration as well as blood circulation [3, 21].

In Europe, grasslands belong to the *Molinio-Arrhenatheretea* class, including mainly half-natural and anthropogenic turf communities of grasslands and pasture [22-26]. Grassland communities are widespread across the whole Euro-Siberian region, on lowlands, highlands and foothills. In many regions of Europe, they belong to the group of the most important vegetation structures defining the physiognomy of a landscape [22, 23]. The meadows of the *Cnidion dubii* association are Natura 2000 natural habitats, protected throughout the European Union. Their code is – 6440 (Interpretation Manual of European Union Habitats. 2013) [27]. However, despite the fact that they are protected, they require extensive but systematic use (mowing once or twice a year) and therefore hay from these meadows is generally available and can be used in medicine. Despite their great economical, importance and undeniable cognitive-educational values, hay groups are still insufficiently examined when it comes to their importance in phytotherapy and in balneology. To date only the general medical properties of hay have been taken into consideration, without any division into syntaxonomical/phytosociological units. However, depending on the participation of different medicinal species (in a given phytosociological alliance of meadows), hay certainly has specific medical properties which have not yet been studied in detail.

In Central Europe, grassland communities belong to two phytosociological orders: *Molinietalia caeruleae* (permanently or periodically humid, fertile hay meadows), with five alliances, e.g., *Cnidion dubii*, and *Arrhenatheretalia* (fertile meadows on moderately moist mineral soils), with three alliances [24]. The order *Molinietalia caeruleae* includes mainly moist mesotrophic and eutrophic harvestable grasslands, as well as riverside herb communities which are permanently or periodically humid and common among lowlands and highlands [22, 23, 25-29]. In the Sebastian Kneipp method, the main attention in the preparation of the raw material is placed on grass seeds, which are the main components of meadows [19, 30, 31]. In Italy, however, hay is used from meadows above 1200

meters above sea level with numerous dicotyledonous plants, including: *Arnica montana*, *Achillea millefolium*, *Alchemilla vulgaris*, *Plantago media*, *Thymus serpyllum*, *Taraxacum alpinum*, *Vaccinium myrtillus*, *Gentiana lutea* [10, 32, 33].

AIM

The main purpose of the work was to analyse the usefulness of hay from *Cnidion dubii* meadows in the valley of the Vistula river (Poland, Central Europe) in hay therapy (*fenum*) in phytobalneootherapy in Sebastian Kneipp's method.

MATERIALS AND METHODS

Phytosociological relevés concerned seven selected uniform patches (Table 1), typical and representative for *Cnidion dubii* meadows in larger areas along the Vistula valley (Figure 1). The plant communities were characterized on the basis of these relevés following the method of the Zurich-Montpellier School of Phytosociology [28]. It is commonly used in Europe for the determination of the preservation and directions of transformation of plant communities. The phytosociological nomenclature and the syntaxonomical appendix are based on Oberdorfer (1994) and Matuszkiewicz (2007) [23, 24]. The species names of vascular plants are given according to The Plant List 1.1. Healing properties of herbs were given according to Länger and Kubelka (2001), Quattrocchini (2012) [34, 35]. Treatments using the Sebastian Kneipp method with the use of hay include: warm baths, half-baths, sitting and partial baths, as well as compresses made of hay bags and compresses. Kneipp only used hay bags for hay treatments [2-8].

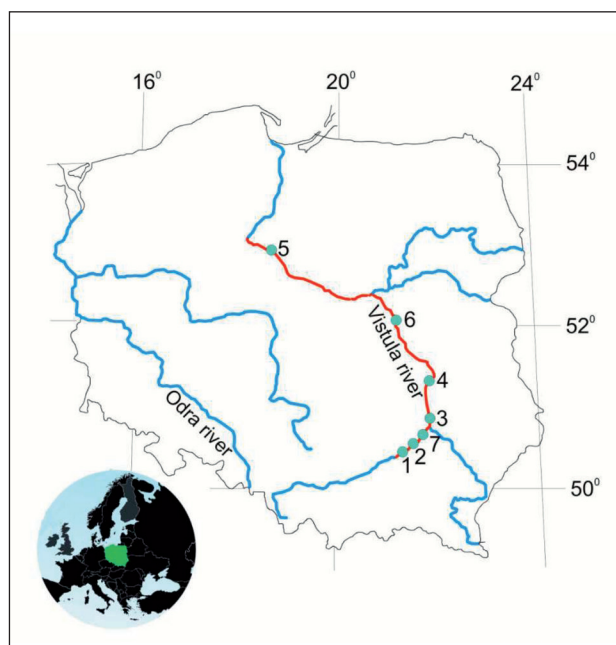


Figure 1. Area of research (in red).

Table 1. *Cnidion dubii* meadows in the valley of the Vistula river in Poland (medicinal plants in bold).

Relevé number	1	2	3	4	5	6	7	C.
Date: day	22	22	09	09	10	10	20	
month	07	07	07	07	07	07	05	
year	2019	2015	2015	2016	2017	2017	2018	
Cover of herb layer [%]	100	100	85	100	100	100	100	
Area of relevé [m ²]	15	20	20	20	20	30	20	
Number of species in relevé	10	11	16	17	17	11	20	
<i>Ch. Cnidion dubii</i>								
Allium angulosum	4	4	4	3	3	4	4	V
<i>Cnidium dubium</i>	.	.	.	1	1	.	.	II
<i>Ch. Molinietales</i>								
<i>Cirsium palustre</i>	.	+	+	+	+	+	+	V
<i>Lotus uliginosus</i>	.	+	+	+	+	+	+	V
<i>Scirpus sylvaticus</i>	+	1	+	.	.	+	+	IV
<i>Juncus articulatus</i>	.	+	.	+	1	+	+	IV
<i>Dactylorhiza majalis</i>	.	.	+	+	+	+	+	IV
Sanguisorba officinalis	1	.	1	+	+	.	.	III
<i>Galium uliginosum</i>	.	.	+	+	+	.	.	III
Succisa pratensis	+	.	+	+	.	.	.	III
<i>Deschampsia caespitosa</i>	.	.	.	2	.	.	2	II
Lysimachia vulgaris	1	.	1	.	.	.	.	II
<i>Epilobium palustre</i>	.	+	.	.	.	.	+	II
<i>Lythrum salicaria</i>	.	.	+	.	.	.	+	II
Lychnis flos-cuculi	.	.	.	+	.	.	+	II
<i>Ch. Molinio-Arrhenatheretea</i>								
Achillea millefolium	+	1	1	1	1	+	+	V
Rumex acetosa	.	.	+	1	.	+	1	III
Centaurea jacea	+	+	.	+	+	.	.	III
Ranunculus acris	.	.	+	.	1	.	+	III
<i>Lathyrus pratensis</i>	.	.	.	+	+	.	+	III
<i>Briza media</i>	.	.	.	.	+	+	.	II
<i>Accompanying species</i>								
Potentilla erecta	.	+	.	.	+	+	+	III
<i>Agrostis canina</i>	+	.	1	.	.	.	+	III
<i>Carex nigra</i>	.	.	.	+	1	.	+	III
<i>Anthoxanthum odoratum</i>	.	.	.	.	1	+	+	III
Menyanthes trifoliata	+	+	+	.	.	.	.	III
<i>Viola palustris</i>	+	+	.	.	+	.	.	III
<i>Ranunculus flammula</i>	.	.	+	.	.	.	1	II
<i>Carex panicea</i>	.	.	.	+	.	.	+	II

Note: Ch. – characteristic species (of phytosociological units), C. – constancy (V – occurrence in 7 or 6 of all 7 phytosociological relevés; IV – occurrence in 5 of all 7 relevés; III – occurrence in 4 or 3 of all 7 relevés; II – occurrence in 2 of all 7 relevés; I – occurrence in 1 of all 7 relevés); constancy confirms that the species is linked to this type of plant community

REVIEW

MEDICINAL PLANTS FOUND IN *CNIDION DUBII* MEADOWS

We recorded 29 vascular plant species growing in the *Cnidion dubii* meadows, among which 11 are known from their medicinal properties: *Allium angulosum*, *Achillea millefolium*, *Centaurea jacea*, *Lychnis flos-cuculi*, *Lysimachia vulgaris*, *Menyanthes trifoliata*, *Potentilla erecta*, *Ranunculus acris*, *Rumex acetosa*, *Sanguisorba officinalis*, *Succisa pratensis* (Table 2). The predominant medicinal species in this type of meadow were *Allium angulosum* and *Achillea millefolium*. The remaining medicinal plants occurred with a smaller share. The number of medicinal species varied in each patch/relevé from 4 to 6, which constituted 44-67 % of their biodiversity/abundance. Proportionally to all plant species, the highest number of medicinal species were found in patch

no. 1 (50 %) followed by other patches (25-38 %). Medicinal species dominated in four (1, 2, 3 and 6) out of seven patches.

TREATMENT PROCEDURES WITH HAY (*FENUM*) IN PHYTOBALNEOTHERAPY WITH RESPECT TO THE DIVERSITY OF *CNIDION DUBII* MEADOWS

Full bath, three-quarter bath, half-bath

Healing baths are done in so called suspension, i.e. highly diluted hay at about 37°C for 20 minutes.

Partial bath of hands or legs

The bath is done in tubs filled with hay suspension. Temperature ca. 27-38°C.

Complete wrap

A woollen blanket, foil and linen fabric is spread on a treatment table or a couch. A 1-2 cm thick layer of hay

Table 2. Medicinal plants of *Cnidion dubii* meadows found in the valley of the Vistula river in Poland and their effects and use in phytobalneoology. Healing properties are given according to Langer et al.

Species	Effects	Uses
<i>Allium angulosum</i>	antibacterial	poultices, wrappings, baths
<i>Achillea millefolium</i>	inflammatory, disinfecting, antifungal	full baths, poultices, compresses
<i>Centaurea jacea</i>	antioxidant, soothing and anti-inflammatory	washing, compresses, poultices
<i>Lychnis flos-cuculi</i>	antibacterial, protozoocidal, antifungal and antiviral	poultices, wrappings, baths
<i>Lysimachia vulgaris</i>	antibacterial agent, skin and hair care, for lichen, eczema	baths, bathing
<i>Menyanthes trifoliata</i>	neuralgia, rheumatism	poultices, wrappings, baths, compresses, poultices
<i>Potentilla erecta</i>	inflammatory, antibacterial and antiviral, wounds, ulceration	poultices, wrappings, baths, compresses, poultices
<i>Ranunculus acris</i>	antirheumatic, antispasmodic, calming inflammation of wounds, ulcers and inflammation of the skin	baths, bathing, halfbaths,
<i>Rumex acetosa</i>	strengthening the defenses of cells affected by bacteria, fungi, viruses, allergens	poultices, wrappings, baths
<i>Sanguisorba officinalis</i>	antidiarrheal, hyperemic, antiseptic	baths, halfbaths, washing
<i>Succisa pratensis</i>	strong anti-inflammatory	washing, compresses, poultices

slurry is applied on patient's body by a paintbrush, while checking the temperature and consistency. Then, the patient is wrapped in the foil, fabric and blanket. The patient should be watched over the entire procedure. Due to complete immobilisation, the patient may get scarred sometimes. Then, it is necessary to free at least one limb. During hot wraps, it is recommended to apply a cold compress on the forehead or near the heart. Duration 20-30 minutes.

Partial wrap

It is done as the complete wrap, but only on one part of the body, e.g. cervical spine, arms. The duration and temperatures as in the above procedures.

Kneading of warm clay slurry

The procedure consists in kneading hay slurry at ca. 45°C for 10-15 minutes. This procedure is applied primarily in arthrosis within the interphalangeal joints of the upper limb.

Poultices and compresses

They are done with a hay cake with dimensions 20×30 cm and thickness 1-2 cm, heated to 45°C, and by applying it on the treated area. After the treatment, the material is washed from the body in a bath or shower at ca. 37°C. The patient should rest for 30 minutes after the procedure. Complete procedures are done in two-day intervals, and the partial ones can be performed every day. A series includes 10-20 sessions.

DISCUSSION

Hay treatments are among the most common of the most frequently applied in clinics and spa treatments and the renewal of the Kneipp method and are most often the „morphine of natural medicine“ [3, 19]. In addition to the pharmacodynamic effects with hay composition, these treatments have an additional end effect. The treatments have a relaxing and analgesic effect, increasing local

blood circulation and improving tissue trophism. Kneipp's phytotherapy, whose sources lie in centuries-old folk knowledge, and which for a long time was attributed only cultural significance, now shows an amazing compatibility with the modern state of medical knowledge [4, 19]. Compounds isolated from plants constitute a large group of substances used in medicine: alkaloids, e.g. quinine - used in the treatment of malaria, morphine - used to combat pain, cardenolide glycosides, tannins and galenic preparations made from various parts of plant material, containing, in addition to ballast products, compounds action of a specific nature. A large group of antibiotics and cholesterol-lowering drugs had their prototype in compounds of plant origin [34]. The use of hay treatments gives a chance to improve the quality of life and to minimize the side effects in the case of many civilization diseases related to lifestyle and in the broadly understood prophylaxis and biological regeneration. Moist *Cnidion dubii* meadows in Europe occur in the fertile valleys of large rivers in their middle and lower reaches. They belong to grasslands that are extensively used, mowed once or twice a year. They are often flooded by flood waters, but they also have repeated periods of dryness. The vegetation of these meadows is adapted to periodic, variable, and very diverse water relations [22, 23, 25, 26, 36].

In the valley of the Vistula river in Poland, *Cnidion dubii* grasslands are habitat for more than 11 medicinal plant species, that mostly dominant there. Hay, from these meadows, is appropriate for balneotherapy and spa resort treatment. Namely, our analysis shows that *Cnidion dubii* hay in the median and lower valley of the Vistula river in Poland consists of medicinal herbs, which have various healing properties such as antibacterial, anti-inflammatory,

protozoocidal, antifungal, antiviral, congestive, antiseptic, anti-rheumatic, antispasmodic, and antioxidant. It confirms that *Cnidion dubii* hay can be used in, e.g., soothing of inflammations of wounds, ulcers and inflammations of the skin [19, 34, 35].

Knowledge of these grasslands is helpful in the usage of the hay in the prevention as well as therapy of many diseases like: Bechterew's disease, rheumatoid arthritis in the non-acute phase, arthrosis of the joints of the upper and lower limbs, pain syndromes of the cervical and lumbar spine in the non-acute phase, neuralgia, enthesopathies of muscles and tendons, states of increased tone of the skeletal muscles and smooth internal organs, dysmenorrhea, tendency to boils and blemishes, leg ulcers, skin inflammations, atopic skin lesions, skin care, as well as a treatment accelerating the body's regeneration processes in biological regeneration and professional sports. Despite the long tradition of using hay treatments using the Kneipp method in spa treatment in many European countries, the syntaxonomic determination of meadows and the hay used for their treatments has not been dealt

with so far. The above results indicate the desirability of this type of research, because the floristic composition of various types of meadows allows for precise determination of their therapeutic indications.

CONCLUSIONS

Hay from the *Cnidion dubii* meadows in the Vistula valley in Poland has antibacterial, anti-inflammatory, protozoocidal, antifungal, antiviral, congestive, antiseptic, anti-rheumatic, antispasmodic, and antioxidative properties, and is soothing to inflammations of the skin. Indications: Bechterew's disease, rheumatoid arthritis in the non-acute phase, arthrosis of the joints of the upper and lower limbs, pain syndromes of the cervical and lumbar spine in the non-acute phase, neuralgia, enthesopathies of muscles and tendons, states of increased tone of the skeletal muscles and smooth internal organs, dysmenorrhea, tendency to boils and blemishes, leg ulcers, skin inflammations, atopic skin lesions, skin care, as well as a treatment accelerating the body's regeneration processes in biological regeneration and professional sports.

References

- Lindström B, Kriksson M. Contextualizing salutogenesis and Antonovsky in public health development. *Health Prom Inter.* 2006;21(3):238-244.
- Bachman RM, Schleinkofer GM. *Die Kneipp-Wassertherapie.* Georg Thieme Verlag. Stuttgart. 1992, 302 p.
- Frochlich HH, Müller-Limmroth W. Physical investigations into the thermotherapeutic action of the Kneipp hay flower sack. *Münchener Medizinische Wochenschrift.* 1976; 187 (12): 317-320.
- Locher C, Pforr C. The legacy of Sebastian Kneipp: linking wellness, naturopathic, and allopathic medicine. *J Alternat Complement Med.* 2014; 20(7):521-526.
- Volger E, Brinkhaus B. *Kursbuch Naturheilverfahren: für die ärztliche Weiterbildung.* Elsevier. München. 2017, 284 p. (in German).
- Kneipp S. *Pflanzen-Atlas zu Seb. Kneipp's "Wasser-Kur",* enthaltend die Beschreibung und naturgetreue bildliche Darstellung von sämtlichen in dem genannten Buche besprochenen, sowie noch einigen andern vom Volke vielgebrauchten Heil-Pflanzen. J. Kasel Verlag. Kempten. 1892, 179p. (in German).
- Eckftein F, Flamm S. *Die Kneipp-Kräuterkur.* Gesundheits Verlag GmbH. Bad Wörishofen. 1933, 296p. (in German).
- Kneipp S. *Mein Testament für Gesunde und Kranke.* Kösel Verlag. Kempten. 1894, 204p. (in German).
- Kneipp S. *Meine Wasser-Kur.* Kösel Verlag. Kempten. 1896, 135p. (in German).
- Antonelli M, Donelli D. Phytobalneotherapy: when traditional herbal medicine meets SPA therapy. *Euro J Integrat Med.* 2018;4: 21-22.
- Brinkhaus B, Kohnen R, Hahn EG. Phytobalneotherapy (hay bath) with *Graminis flos* vs. hydrotherapy: A prospective cross-over study. *Europ J Integrat Med.* 2009;1: 173-174.
- Miori R, Contu C, Marzano A et al. Critical evaluation of phytothermotherapy ("hay baths") in degenerative arthropathies. *Clin Terap.* 1994;144:31-42.
- Miori R, Paolazzi G, Albertazzi R et al. Fitobalneoterapia con bagni nell'erba di montagna in fermentazione nella gonartrosi: risultati a medio-lungo termine. [Phytothermotherapy with fermenting alpine grass in knee osteoarthritis: mid-long term results Reumatismo]. 2008;60 (4):282-289. (in Italy).
- Fioravanti A, Bellisai B, Capitani S et al. Phytothermotherapy: a possible complementary therapy for fibromyalgia patients. *Clin Exper Rheumatol.* 2009;27(5), 21-24.
- Spalek K, Trzewikowska I. Herbal treatment within the framework of Sebastian Kneipp's method used in health resorts in Germany. *Post Fitoter.* 2007;4:213-216.
- Spalek K, Trzewikowska I, Słonka K. Hay therapy (fenum) in phytobalneotherapy with allowance of diversity of grassland community in Poland. *Nature J.* 2010; 43:5-12.
- Trzewikowska I. Place of Sebastian Kneipp's method in modern physiotherapy. *Fizjoterapia.* 2003;11:65-71.
- Trzewikowska I. Treatment of chronic obstruction of peripheral arteries with the use of Sebastian Kneipp's method. *Fizjoterapia.* 2003;11:72-77.
- Maertens O. *Heilkräuter nach Sebastian Kneipp.* Verlag des Österreichischen Kneippbundes. Wien. 2003, 182p.
- Brinkhaus B, Lindner M, Schwenk M et al. Phytobalneotherapie mit *Graminis flos* (Heublumen) versus „Wärme-Bad“. *Perfusion.* 2009;13:476-485.
- Goedsche K, Förster M, Kroegel C, Uhlemann C. Repeated cold water stimulations (hydrotherapy according to Kneipp) in patients with COPD. *Forsch Komplementmed.* 2007;14:158-166.
- Ellenberg H. *Vegetation Mitteleuropas mit den Alpen in ökologischer, dynamischer und historischer Sicht.* Verlag Eugen Ulmer. Stuttgart. 1996, 54p.
- Matuszkiewicz W. *Przewodnik do oznaczania zbiorowisk roślinnych Polski.* Wydawnictwo Naukowe PWN. Warszawa. 2007, 540p.
- Oberdorfer E. *Pflanzensoziologische Exkursionsflora.* Verlag Eugen Ulmer. Stuttgart, 1994, 1056p.
- Pott R. *Die Pflanzengesellschaften Deutschlands.* 2 Auflage. Verlag Eugen Ulmer. Stuttgart. 1995, 622p.
- Schubert R, Hilbig W, Klotz S. *Bestimmungsbuch der Pflanzengesellschaften Mittel- und Nordostdeutschlands.* G. Fischer Verlag, Jena-Stuttgart. 1995, 312p.
- Interpretation Manual of European Union Habitats. EUR 28. April 2013. European Commission DG Environment. *Nature ENV B.3.*
- Braun-Blanquet J. *Pflanzensoziologie, Grundzüge der Vegetationskunde.* Springer Verlag. Wien-New York. 1964, 208p.

29. Rennwald E et al. Rote Liste der Pflanzengesellschaften Deutschlands mit Anmerkungen zur Gefährdung. Verzeichnis und Rote Liste der Pflanzengesellschaften Deutschlands. Schriftenreihe für Vegetationskunde 2000;35: 393-592.
30. Brinkhaus B, Kohnen R, Hahn EG. Phytobalneotherapy (hay bath) with Graminis flos vs. hydrotherapy: A prospective cross-over study. *Europ J Integrat Med.* 2009; 1(4): 173-174.
31. Hentschel C, Brinkhaus B, Lindner M et al. Phytobalneotherapy using Flores Graminis (HAY) – prospective study of the transdermal absorption of coumarin. *Focus Alternat Compl Therap.* 1997;2:189-190.
32. Tenti S, Manica P, Galeazzi M, Fioravanti A. Phytothermotherapy in fibromyalgia and osteoarthritis: between tradition and modern medicine. *Europ J Integrat Med.* 2013;5:248-253.
33. Talamucci P, Piemontese S, Coser P. Risultati preliminari sulle modalità di utilizzazione e di conservazione dell'erba dei pascoli del Monte Bondone a fini terapeutici ("bagni di fieno"). [Preliminary results on the procedures for the use and conservation of grass in the pastures of Monte Bondone purposes terapeutici ("hay baths")]. *Report Centro di Ecologia Alpina.* 1995;1:1-20. (in Italy).
34. Quattrocchini U. *CRC World Dictionary of Medical and Poisonous Plant.* CRC Press Taylor & Francis Group. London, New York. 2012, 408p.
35. Länger R, Kubelka W. *Phytokodex – Pflanzliche Arzneispezialitäten in Österreich 2001\2002.* Krause & Pchneregg GmbH, Verlag für Medizin und Wirtschaft. Gablitz. 2001, 423p. (in German).
36. Balátová-Tuláčková E. Beitrag zur Kenntnis der tschechoslowakischen Cnidion venosi-Wiesen. *Vegetatio.* 1969;17:200-207. (in German).

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CONFLICT OF INTEREST

The Author declare no conflict of interest

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APPLICATION OF SYSTEMIC CRYOTHERAPY IN COSMETOLOGY

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ABSTRACT

Aim: The aim of this study was to assess the use of whole-body cryotherapy in cosmetology.

Materials and Methods: Literature review was conducted based on the available PubMed bibliographic database from 2012 to 2022. Articles in Polish, English and Russian were included. Keywords such as whole-body cryotherapy, cryogenic chamber, and cryotherapy in cosmetology were used during the publication search.

Conclusions: Whole-body cryotherapy is safe for the skin and has minimal effect on changes in pH, moisture and oiliness. Cryotherapy in a cryo-chamber can be used as complimentary therapy for the treatment of skin dermatoses and can also be a non-invasive method of treating various types of hair loss. It can also be an alternative method of reducing body fat.

KEY WORDS: whole-body cryotherapy, cryogenic chamber, cryotherapy in cosmetology

INTRODUCTION

Whole-body cryotherapy is a procedure that involves exposing the entire body surface to extremely low temperatures, during which the patient undergoes 2-3 minutes of stimulation at a temperature below -100°C, with the aim of inducing physiological reactions to cold [1-2].

Cryotherapy is one of the most dynamically developing areas of modern physical medicine. Regular research confirming the physiological benefits of extreme low-temperature exposure on the human body encourages the popularization of whole-body cryotherapy, including its use in cosmetology.

Poland is a leader in the production of cryochambers and research in this field. Over the last few decades, the impact of cryogenic chamber treatments on the human body has been well described, but studies on its application in cosmetology are still lacking.

AIM

The aim of the study was to evaluate the use of whole-body cryotherapy in cosmetology.

MATERIALS AND METHODS

A literature review was conducted based on the available PubMed bibliographic database from 2012-2022. Articles in Polish, English, and Russian were included. During the search for publications, keywords such as whole-body cryotherapy, cryogenic chamber, and cryotherapy in cosmetology were used.

REVIEW AND DISCUSSION

In recent years, more and more research has been conducted to confirm the validity of using whole-body cryotherapy in cosmetology. Currently, its positive effect on the body's

antioxidant capacity and its safety for the skin have been proven [3-6]. Extreme low-temperature therapy appears to be a safe, non-pharmacological method that supports the treatment of skin dermatoses [7-10]. The use of cryogenic temperatures is becoming increasingly popular as a slimming, anti-cellulite, or wrinkle-reducing treatment [11]. Another interesting possibility is the use of whole-body cryotherapy in women struggling with abdominal obesity [12].

Over the years, studies have been conducted [4] that have assessed the role of oxidative stress and its effects on the skin aging process. An imbalance between free radical synthesis and antioxidant defense leads to oxidative stress, which can cause damage to lipids, proteins, and nucleic acids, thereby contributing to their apoptosis in various types of cells.

Reactive oxygen species generated in skin cells by enzymes such as nicotinamide adenine dinucleotide, xanthine oxidoreductase, peroxisomal oxidases, cyclooxygenases, and cytochrome P450 enzymes are associated with skin photoaging [5].

Ultraviolet UVA radiation also leads to the generation of free radicals such as superoxide, hydroxyl radical, and hydrogen peroxide, causing damage to cells in both the dermis and epidermis. Reactive oxygen species are associated with damage to nuclear and mitochondrial deoxyribonucleic acid (DNA) [5]. Destruction of a particle containing genetic information increases the production of additional intracellular free radicals, which further propagates the cycle of cell damage. Previous studies suggest that whole-body cryotherapy reduces the amount of reactive oxygen species and has a positive effect on the body's antioxidant capacity, so it may be used as a supportive therapy in the treatment of diseases associated with oxidative stress [5].

The results of Miller et al.'s [4] study indicate that treatments in a cryochamber stimulate the body's antioxidant response by increasing the activity of superoxide dismutase, increasing the total antioxidant state, and increasing the level of uric acid. Superoxide dismutase is the main enzyme of the antioxidant barrier. In reactions catalyzed by this enzyme, it protects against the formation of the most active reactive oxygen species - the hydroxyl radical. Uric acid, on the other hand, is a strong antioxidant that is responsible for the total antioxidant state in blood serum. Two groups were included in the study - the first received 10 three-minute sessions of whole-body cryotherapy, while the second group consisted of individuals without exposure to a cryogenic chamber. The first group included 46 volunteers (22 women and 24 men), while the second group included 26 women and 22 men. The mean age of the participants was 37.5 (± 3.1). Blood samples were taken twice from both groups at a 10-day interval. The evaluation included, among other things, lipid peroxidation, antioxidant enzyme activity, and uric acid concentration.

Wójciak et al. [6] also addressed the issue of the influence of whole-body cryotherapy on the oxidative state of the body in their work. The study involved 40 men who underwent 24 sessions of whole-body cryotherapy over the course of 8 weeks. The therapy was performed three times a week (Monday, Wednesday, Friday). Healthy Caucasian men from two age groups (18-30 years and 55-70 years) who had been training in long-distance running for at least 2 years were included in the study, as well as non-training individuals (control group) who had no contraindications for whole-body cryotherapy. All volunteers were divided into two additional groups, the first consisting of 10 non-training young and older men, and the second consisting of 10 older and 10 younger long-distance runners. The study evaluated the concentration of selected sirtuins in the blood as well as the level of antioxidant defense and the oxidative stress index in both trained and untrained men depending on their age. Sirtuins are groups of proteins that have the ability to silence certain genes, so-called aging genes [13]. Sirtuin 1 activates mitochondrial DNA repair processes, regulates mitochondrial biogenesis, and delays cell apoptosis, while also increasing the activity of superoxide dismutase and catalase. Sirtuin 3 helps maintain energy balance in the cell, preventing apoptosis under conditions of oxidative stress, increasing the activity of superoxide dismutase, and contributing to the maintenance of proper reactive oxygen species levels. During the evaluation of the results, it was observed that cryogenic temperatures increase the level of sirtuin 1 and sirtuin 3 in the blood as well as the overall antioxidant defense in men, but this effect is age-dependent, dependent on the level of physical activity performed, and the number of treatments used. After a single exposure in the cryogenic chamber, the serum level of sirtuin 1 increased in older men engaging in high physical activity, while after 24 treatments, an increase in both sirtuin 1 and sirtuin 3 was observed in the same group. At the same time, no significant changes in the level of sirtuin 1 and 3 were observed among older, non-training men. In young,

low-physical-activity individuals, an increase in sirtuin 1 was observed after 12 cryochamber treatments, and this effect was amplified after 24 treatments. No changes in sirtuin 1 and 3 concentrations were observed in the trained participants in the same age group [6].

A literature review [14], dedicated to the role of 25-hydroxyvitamin D in the pathogenesis of skin diseases, allows us to see how serious of a problem its deficiency is. Too low levels of this vitamin can lead to a disturbance of the physiological homeostasis of the body, contributing to the deterioration of skin condition. Abnormal levels of this vitamin may be the cause of allergic skin diseases and often accompany some skin conditions, such as: pemphigus, psoriasis, systemic lupus erythematosus.

Śliwicka et al. [15] evaluated the effect of whole-body cryotherapy on the levels of 25-hydroxyvitamin D, myokines, myoglobin, and high-sensitivity C-reactive protein. The study included 22 healthy male volunteers aged 21-23 years, with varying levels of physical fitness, who underwent a series of 10 treatments in a cryogenic chamber once a day for 3 minutes. The young men were divided into two groups based on their level of physical fitness, with the first group comprising individuals with low physical fitness and the second group comprising individuals with high physical fitness. Blood samples were taken from all volunteers 30 minutes before and 24 hours after the first and last cryotherapy session. Body composition and physical activity levels were also measured before the therapy began. After completing the full series of treatments, significant changes in myostatin levels were observed in the first group. Levels of 25-hydroxyvitamin D increased in the second group, while they decreased in the low physical fitness group. In the high physical fitness group, significant changes in the level of high-sensitivity interleukin-6 were observed after the first treatment. Differences in the levels of 25-hydroxyvitamin D, irisin, and myostatin were observed in the first group after 10 days of cryotherapy. The data showed that whole-body cryotherapy has a minimal and transient effect on the level of 25-hydroxyvitamin D.

Piotrkowska et al. [16] evaluated the effects of cryogenic chamber treatments on the skin of young individuals with an average age of 23.63 (± 1.36) years. The study included 43 women and 33 men who participated in a single 3-minute treatment, with skin measurements taken on the forearm and (in men) on the face before and after the treatment. The researchers observed that the skin on the upper limbs reacts differently to cryogenic stimulation than the skin on the face. Significant differences were observed in the hydration of the stratum corneum and trans-epidermal water loss between the groups of women and men. After a single treatment, the skin characteristics of the forearm did not change, while an unfavorable increase in trans-epidermal water loss from the skin was observed on the faces of men. The study concluded that a single visit to the cryogenic chamber, when proper treatment methodology is observed, is safe for the skin. Additionally, the researchers found that changes in the skin depend on the area of the body being treated.

The study conducted by Skrzek et al. [8] on 20 women showed that after a series of 10 whole-body cryotherapy treatments, the most significant changes were observed in skin hydration and temperature. The study participants had an average age of 58.7 (± 7.54) years, an average body weight of 77.84 (± 16.01) kg, an average height of 160.7 (± 6.48) cm, and an average body mass index of 30.14 (± 5.81). The parameters evaluated in different body areas included skin hydration, sebum content, skin temperature, and pH. Measurements were taken before and after exposure to the cryogenic chamber on the first and 10th days of the study. During the observation, a decrease in skin hydration and temperature was noticed. The analysis of the results showed differences in the parameters between all measurement areas. It was observed that the upper and lower limbs were more sensitive to extremely low temperatures than other body areas, and the skin on the face was more hydrated and oilier compared to other measurement areas. The study also showed that cryotherapy treatments had a minimal effect on skin pH and sebum content.

In a study conducted by Misiorek et al. [17], 16 people (8 women and 8 men) who underwent 15 sessions of whole-body cryotherapy were observed by measuring skin parameters before the first session, immediately after the session, and 3 weeks after the end of the therapy. The results showed that there were no significant differences in skin moisture and pH among the participants. However, the level of sebum significantly decreased after the second session in the cryogenic chamber. The study also suggests that whole-body cryotherapy appears to be safe for the skin.

The study conducted by Kępińska-Szyszkowska et al. [9] proposed the hypothesis that cryotherapy chamber treatments may be an effective and supportive method of treatment for atopic dermatitis. The study involved 14 adults (7 women and 7 men), aged 32 (± 10.8) years, with mild or moderate atopic dermatitis. The participants did not use any topical anti-inflammatory preparations or antihistamines for a week before and during the treatments. The cryotherapy chamber sessions were conducted once a day for 15 days. Skin parameters such as skin moisturization, sebum level, and pH were measured. Eight out of 14 patients (5 women and 3 men) completed the treatment period. Two patients withdrew from the study due to worsened skin inflammation, while the other 4 withdrew due to reasons unrelated to their skin condition. The evaluation of the study showed changes in the level of skin moisturization, both in healthy skin and in diseased skin. In the latter, the level of moisturization increased immediately after the treatment and also after 3 weeks from the last session. The level of sebum and pH did not change, but the degree of atopic dermatitis decreased, as determined by the level of its severity.

Klimenko et al. [10] presented the influence of whole-body cryotherapy on atopic dermatitis in their study. The study included 18 volunteers (8 women and 10 men) with mild to moderate atopic dermatitis. Participants with cardiovascular diseases, asthma, skin diseases, and cold urticaria were

excluded. Whole-body cryotherapy sessions were conducted three times a week for four weeks. Ultimately, 16 patients completed the therapy, with an average of 11 sessions per person. Most participants, except for two individuals, described the sessions as "somewhat cold" to "extremely cold." Nonetheless, they considered the entire therapy to be pleasant. After the completion of the therapy, the mean index of the severity of atopic dermatitis reduced by 19.6% in individuals who underwent whole-body cryotherapy. The sensation of itchiness decreased by 32.6%, and the index of trans-epidermal water loss improved by 19.4%.

The study by Olisova et al. [18] investigated the effect of whole-body cryotherapy using the Icequeen cryo-capsule on individuals with various dermatoses. The study presented a modern way of treating chronic immunologic skin diseases using the Icequeen device. The Icequeen is a single-person, closed-type cryotherapy system that provides body cryotherapy, except for the facial skin. During the procedure, the individual undergoing therapy breathes atmospheric air through a special opening. The study involved 18 patients (10 females and 8 males) with moderate to severe atopic dermatitis, aged 17 to 63 years; 8 individuals (6 females and 2 males) with lichen planus, aged 36 to 50 years; 6 patients (2 females and 4 males) with acne, aged 17 to 25 years; 2 females with toxidermia, aged 40 and 54 years; and 1 female with pruritus, aged 49 years. Additionally, 26 patients (20 females and 14 males) with psoriasis associated with metabolic syndrome, aged 40 to 65 years, were treated, including 17 individuals with plaque psoriasis, 6 with pustular psoriasis, and 3 with psoriatic arthritis. The participants underwent a series of 10 to 15 whole-body cryotherapy sessions, daily or every other day. The effectiveness of therapy was assessed using clinical criteria such as the atopic dermatitis index, the area and severity index of psoriasis, the dermatological index of acne, and the dermatological quality of life index before and after therapy. The intensity of itching and the degree of sleep disturbances were evaluated on a scale of 0 to 10. In patients with metabolic syndrome, insulin and glucose levels in fasting blood and lipid profile were measured. Measurements of body length, body weight, body mass index, waist circumference, blood pressure, and heart rate were also taken. A significant clinical effect was observed in individuals with psoriasis, atopic dermatitis, lichen planus, pruritus, and toxidermia (drug rash). Clinical improvement was observed in all patients with atopic dermatitis in both groups. In the case of combination therapy, there was a more than fourfold reduction in the severity of atopic dermatitis, while in monotherapy, the reduction was more than threefold. The degree of itching before therapy was 8.6 points, and after 4 weeks, it decreased to 1.8 points. However, low effectiveness of whole-body cryotherapy was observed in the treatment of acne. Three patients with acne refused further therapy due to the lack of positive effects of cryotherapy after 4-5 sessions and returned to traditional methods of treatment. At the end of the study, a slight remission was observed in individuals with acne in the form of a decrease in the

number of pimples and the severity of seborrhea. In moderate acne, the reduction in skin lesions was 15–20%, while in severe acne, it was only 8%. In patients with psoriasis, the reduction of the area and severity index of psoriasis was observed at the end of therapy in the first group, with a tendency to relapse in the second group. The reduction in the area and severity index of psoriasis ranged from 65 to 95%.

According to research by Cholewka et al. [19], cryochamber treatments may be related to the patient's body mass index. The results obtained, under the influence of extremely low temperature, showed differences in the decrease in skin temperature of specific body parts in relation to the body mass index of the volunteers, which was also observed in the results of contact thermometry studies. The lowest temperature was observed on the lower limbs. Statistical analysis confirmed the results of thermographic and thermometric studies.

Cryotherapy treatments appear to be an interesting alternative in the treatment of alopecia areata, androgenic alopecia, telogen effluvium, and in people struggling with hair loss after chemotherapy [20]. Compared to invasive methods that often have unwanted side effects, cryotherapy could be a safe and painless method of treatment. However, its effective action in treating the mentioned types of hair loss has not been proven so far.

In studies [21], the impact of irisin on metabolic diseases is increasingly being presented. Irisin is an adipokine, specifically a protein peptide called FNDC5 (Fibronectin type III domain-containing protein 5), which improves overall metabolism by increasing energy expenditure. The protein mentioned above stimulates the process of browning of white adipose tissue. Brown adipose tissue, due to the presence of numerous mitochondria and the ability to dissipate energy in the form of heat (non-shivering thermogenesis), counteracts obesity and related diseases.

Więcek et al. [12] demonstrated in their study that cryotherapy treatment, consisting of 20 sessions, can lead to a reduction of abdominal obesity in menopausal women, indirectly through the secretion of irisin and interleukin IL-6, and may be used as a supportive therapy for metabolic syndrome. The study involved 19 women with metabolic syndrome and 18 healthy women, who underwent 20 whole-body cryotherapy sessions, in four series of 5 treatments, with two-day breaks in between. In both groups, body weight, body mass index, waist circumference, triceps skinfold thickness, total fat mass, and percentage of fat in the lower limbs were significantly reduced after the 20 cryotherapy treatments. Additionally, the percentage of total body and abdominal fat in the group of women with metabolic syndrome significantly decreased after the completion of the full therapy. Waist circumference and waist-to-height ratio significantly decreased in both groups, while hip circumference and abdominal skinfold thickness significantly decreased in the group of healthy women after 20 cryotherapy treatments. The irisin concentration in serum significantly increased

after the first and tenth cryotherapy treatments, while the interleukin IL-6 concentration significantly increased only in the first group of women after 10 and 20 exposures, and was higher than in the group of healthy women. Meanwhile, the C-reactive protein concentration was lower after the full series of treatments in both groups of women studied.

In the subject literature [22], studies assessing the role of asprosin in the pathogenesis of diseases belonging to the metabolic syndrome can be found. It has been proven that the concentration of this protein is strongly elevated in humans and mice with insulin resistance and obesity. Lowering the level of asprosin has a beneficial metabolic effect, such as reducing excessive body weight, reducing appetite, improving tissue sensitivity to insulin, and also improving the glycemic profile.

Więcek et al. [23] demonstrated that whole-body cryotherapy treatments can reduce the level of asprosin in the blood of postmenopausal women. The study included a group of women with metabolic syndrome and a control group. The results confirmed that a series of 20 whole-body cryotherapy treatments in postmenopausal women, regardless of the presence of metabolic syndrome, can reduce asprosin in the blood, which may support the treatment of metabolic disorders, type II diabetes, and insulin resistance.

A study conducted by Ziemann et al. [24] confirmed that whole-body cryotherapy is an effective form of therapy in reducing low-grade inflammation in obese men. It was observed that the presence of excessive adipose tissue and the resulting elevated levels of certain pro-inflammatory cytokines lead to low-grade systemic inflammation in overweight individuals. Adipose tissue contains a large number of macrophages that are a source of tumor necrosis factor, interleukin-6, and other cytokines. The results showed that a series of 10 cryotherapy sessions led to a significant decrease in the level of tumor necrosis factor. The study included 14 obese men, who were divided into two groups based on their cardiorespiratory fitness. In the group with lower cardiorespiratory fitness, the cycle of whole-body cryotherapy sessions resulted in over a four-fold decrease in the level of tumor necrosis factor, while in the second group, the decrease was smaller but still significant. Both groups also showed an increase in the anti-inflammatory cytokine interleukin-10. Lower levels of tumor necrosis factor may be particularly important for individuals with excess adipose tissue, not only due to the reduction of inflammation but also in regulating and disrupting energy metabolism and lipid homeostasis.

Kikowski et al. [25] showed in their study that whole-body cryotherapy combined with kinesiotherapy is an interesting and promising procedure that can serve as an alternative method for reducing body fat. The study included 35 women and 16 men aged 22 to 81 years, with a mean age of 51 years. All participants had chronic back pain. The diet of all participants remained unchanged during the therapy. Participants underwent measurements of body weight, waist and hip circumference, and body composition.

They were divided into a study group (33 individuals) and a comparison group (18 individuals). The study group received a cycle of 10 three-minute cryogenic chamber sessions combined with 30 minutes of kinesiotherapy, for a period of 2 weeks (excluding Saturdays and Sundays). The comparison group only attended kinesiotherapy sessions. After the completion of the treatment cycle, a decrease in all analyzed parameters was observed in both male and female participants in the study group, with a tendency towards a reduction in body fat observed only in the female participants of the study group; no changes were observed in the comparison group.

In conclusion, whole-body cryotherapy may have its application in cosmetology, and this study may serve to spark interest in this topic among other researchers.

CONCLUSIONS

Whole body cryotherapy is safe for the skin and has a minimal impact on changes in its pH, hydration, and sebum levels. The treatment in a cryochamber can be used as a complementary therapy for the treatment of skin dermatoses and can also be a non-invasive method of treating various types of alopecia. It may also be an alternative method for reducing adipose tissue.

References

1. Ponikowska I. Encyklopedia Balneologii i Medycyny Fizykalnej oraz Bioklimatologii, Balneochemii i Geologii Uzdrowiskowej. Konstancin-Jeziorna. Wydawnictwo Aluna. 2015:114-115.
2. Ponikowska I, Kochański JW. Wielka Księga Balneologii, Medycyny Fizykalnej i Uzdrowiskowej. Wydawnictwo Aluna. Konstancin-Jeziorna. 2018.
3. Miller E, Mrowicka M, Malinowska K, Mrowicki J, Saluk-Juszczak J, Kędziora J. Effects of whole-body cryotherapy on a total anti-oxidative status and activities of antioxidative enzymes in blood of depressive multiple sclerosis patients. *World J Biol Psychiatry*. 2011;12(3):223-7.
4. Miller E, Markiewicz Ł, Saluk J, Majsterka I. Effect of short-term cryostimulation on antioxidative status and its clinical applications in humans. *Eur J Appl Physiol*. 2012;112(5):1645-52.
5. O'Connor M, Wang JV, Saedi N. Whole and partial-body cryotherapy in aesthetic dermatology: Evaluating a trendy treatment. *J Cosmet Dermatol*. 2018;18(5):1435-1437.
6. Wójciak G, Szymura J, Szygula Z, Gradek J, Wiecek M. The Effect of Repeated Whole-Body Cryotherapy on Sirt1 and Sirt3 Concentrations and Oxidative Status in Older and Young Men Performing Different Levels of Physical Activity. *Antioxidants (Basel)*. 2020;10(1):37.
7. Piotrkowska A, Aszklar K, Dzidek A, Ptaszek B, Czerwińska-Ledwig O, Pilch W. The impact of a single whole body cryostimulation treatment on selected skin properties of healthy young subjects. *Cryobiology*. 2021;100(1):96-100.
8. Skrzek A, Ciszek A, Nowicka D, Dębiec-Bąk A. Evaluation of changes in selected skin parameters under the influence of extremely low temperature. *Cryobiology*. 2019;86:19-24.
9. Kępińska-Szyszkowska M, Misiorek A, Kapińska-Mrowiecka M, Tabaka J, Malina K. Assessment of the Influence Systemic Cryotherapy Exerts on Chosen Skin Scores of Patients with Atopic Dermatitis: Pilot Study. *Biomed Res Int*. 2020;2020:5279642.
10. Klimenko T, Ahvenainen S, Karvonen SL. Whole-Body Cryotherapy in Atopic Dermatitis. *Arch Dermatol*. 2008;144(6):806-808.
11. Farberg AS, Donohue S, Farberg A, Teplitz RL, Rigel DS. Cutaneous Implications of Whole Body Cryotherapy. *SKIN The Journal of Cutaneous Medicine*. 2017;1(1):15-17.
12. Więcek M, Szymura J, Sproull J, Szygula Z. Whole-Body Cryotherapy Is an Effective Method of Reducing Abdominal Obesity in Menopausal Women with Metabolic Syndrome. *J Clin Med*. 2020;9(9):2797.
13. Dąbrowska E. Dieta dr Ewy Dąbrowskiej: fenomen samo uzdrawiającego się organizmu. Jak działa post warzywno-owocowy. Wydawnictwo WAM. Kraków. 2019:110-111.
14. Sałagan K. Rola witaminy D3 w patogenezie chorób skór. [Role of vitamin D3 in skin diseases pathogenesis]. *Kosmetologia estetyczna*. 2016;5(1):15-22. (in Polish).
15. Śliwicka E, Cisoń T, Straburzyńska-Lupa A, Pilaczyńska-Szczeniak Ł. Effects of whole-body cryotherapy on 25-hydroxyvitamin D, irisin, myostatin, and interleukin-6 levels in healthy young men of different fitness levels. *Sci Rep*. 2020;10(1):6175.
16. Piotrkowska A, Aszklar K, Dzidek A, Ptaszek B, Czerwińska-Ledwig O., Pilch W. The impact of a single whole body cryostimulation treatment on selected skin properties of healthy young subjects. *Cryobiology*. 2021;100:96-100.
17. Misiorek A, Szyszkowska-Kępińska M. Evaluation of the influence of whole-body cryotherapy on selected skin parameters in healthy individuals: pilot study. *Cryobiology*. 2021;100:77-80.
18. Olisowa OJ, Kayumova LN, Smirnow KW, Shuppo OA, Arsentiew NS. Obshchaja krioterapias ispolzovanijemkriokapsuly icequeen pri razlichnykh dermatozakh. [General cryotherapy with the use of cryocapsule ICEQUEEN in patients with various dermatoses]. *Russian J Skin Vener Dis*. 2017;20(1):15-20. (in Russian).
19. Cholewka A, Stanek A, Sieroń A, Drzazga Z. Thermography study of skin response due to whole-body cryotherapy. *Skin Res Technol*. 2011;18(2):180-187.
20. Rymaszewska J, Skrzek A, Giemza C, Kiełar J, Borzymowicz M, Cichoński M, Cięszczyk J, Śliwiński M, Wojciechowski B, Fedyk W, Kabała T, Kikowski Ł. Kodeks Dobrej Praktyki w krioterapii ogólnoustrojowej. Szkoła Wrocławska. Wydanie 3 – nowe i uzupełnione. Wrocław. 2021:20-21.
21. Pukajło K, Kołocko K, Łączmański Ł, Daroszewski J. Iryzyna – nowy mediator homeostazy energetycznej. [Irisin – a new mediator of energy homeostasis]. *Postępy Hig Med Dosw (Online)*. 2015;69: 233-242. (in Polish).
22. Krukowska A, Hoffmann K, Bryl W. Asprozyna – aktualny stan wiedzy. [Asprosin – the current state of knowledge]. *Hygeia Public Health*. 2020;55(3):93-98. (in Polish).

23. Więcek M, Szymura J, Sproull J, Szygula Z. Decreased Blood Asprosin in Hyperglycemic Menopausal Women as a Result of Whole-Body Cryotherapy Regardless of Metabolic Syndrome. *J Clin Med.* 2019;8(9):1428.
24. Ziemann E, Olek RA, Grzywacz T, Antosiewicz J, Kujach S, Łuszczuk M, Smaruj M, Śledziwska E, Laskowski R. Whole-body cryostimulation as an effective method of reducing low-grade inflammation in obese men. *J Physiol Sci.* 2013;63(5): 333-343.
25. Kikowski Ł, Szwaczkó A, Korzycka-Zaborowska B. Ocena parametrów klinicznych metodą bioimpedancji tkankowej u osób poddanych serii zabiegów krioterapii ogólnoustrojowej połączonej z kinezyterapią – doniesienie wstępne. [Evaluation of clinical parameters by tissue bioimpedance in patients undergoing a series of systemic cryotherapy combined with kinesitherapy – preliminary report]. *Acta Balneol.* 2012;54(3):179-186. (in Polish).

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CONFLICT OF INTEREST

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MAGNETO-LED THERAPY IN THE TREATMENT OF VENOUS LEG ULCERS – CASE REPORT

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ABSTRACT

In many countries significant globally health problem of the world is the occurrence of hard-to-heal wounds of various etiologies, which also include venous leg ulcers. The tendency to relapse in this disease entity requires frequent hospitalizations and long-term medical care. In medicine in the comprehensive treatment of chronic wounds physical medicine procedures are increasingly used, thus expanding the range of treatment options. The article presents favorable treatment results of a 81 year old female patient with venous leg ulcers of both lower limbs who was treated with combined physical therapy in the form of magneto-LED therapy using the therapeutic effect of low frequency variable magnetic field and optical radiation. The applied therapy caused complete healing ulcers, reduction inflammation in the surrounding tissues the ulceration and significant reduction pain ailments.

KEY WORDS: combined physical therapy, magneto-LED therapy, physical medicine, treatment, venous leg ulcers

INTRODUCTION

The problem of difficult-to-heal wounds affects about 20 million patients worldwide [1]. Currently, up to 4% of the total expenditure on health care relates to the costs incurred in connection with the treatment of hard-to-heal wounds [1, 2]. In Poland, according to statistical data the problem of wound treatment including chronic wounds affects over 650.000 people, and the costs of their treatment amount to almost 3 billion PLN annually [3, 4]. Chronic wounds are definitely more common in older people, in whom the regeneration of damaged tissues can be much slower, which does not mean that the chronic and difficult to heal wounds do not occur in younger people and are easier to treatment. There is also an increasing trend in the frequency of their occurrence. This is most likely related to the demographic situation and aging of societies as well as the increased incidence of civilization diseases such as obesity, diabetes, hypertension or hypercholesterolemia, which favor the development of such wounds [5, 6].

According to the latest guidelines of the European Wound Management Association and the Polish Society of Wound Treatment, the treatment of hard-to-heal wounds should be based on interdisciplinary activities conducted by qualified medical and therapeutic teams. In many cases, the treatment of chronic wounds at the basic level of medical care is insufficient and does not bring fully satisfactory results. Due to the complex etiopathogenesis of chronic wounds, the best therapeutic effects are achieved only with a comprehensive, multi-directional treatment model that takes into account the synergistic effect of individual therapeutic methods, including also methods in the field

of physical medicine. These procedures often allow to accelerate the healing process and thus shorten patients the treatment time [4, 6, 7].

Magneto-LED therapy is a method of physical combined therapy consisting in the combined, simultaneous impact of a low frequency variable magnetic field with low magnetic induction values (from 1 pT to 100 μ T) and a relatively high frequency of the basic waveform ranging from several dozen to 3000 Hz, which has a complex shape of impulses and structure signals giving a multi-peak frequency spectrum and low-energy light radiation emitted by LED semiconductor diodes. The basic waveforms of the magnetic fields used in magneto-LED therapy correspond to the resonance frequencies for ions exhibiting metabolic activity, such as calcium, sodium or potassium, which is the basis for the phenomenon of ion cyclotron resonance (ICR). On the other hand, low-energy light radiation emitted by semiconductor LEDs has a constant frequency of 181.8 Hz and wavelengths ranging from 630 to 855 nm [8, 9].

The beneficial effects of magneto-LED therapy in the treatment of wounds result primarily from its biological effects, which include among others: intensification of oxygen utilization processes and tissue respiration, intensification of anaerobic respiration in ischemic tissues, anti-inflammatory effect associated with the modulation of the profile of secreted cytokines and vasodilative and angiogenesis related to increased endothelial cell proliferation and fibroblast growth factor (FGF) production. In addition, these treatments cause the development of collateral circulation in the area of the wounds. In addition, both of these physical factors intensify the processes of

tissue regeneration and repair as a result of stimulation of collagen synthesis, stimulation of the epidermalization process and inhibition of infection in the vicinity of wounds. An important fact to emphasize is also the analgesic effect of these methods in the case of coexisting pain. According to the few scientific publications in the available literature, the undoubted advantages of magneto-LED therapy, apart from high therapeutic effectiveness, include its low invasiveness, low cost of the treatment, lack of significant side effects and a small number of contraindications to its use [8-10].

AIM

The aim of the study is to present the beneficial effect of the treatment with the use of magneto-LED therapy in an 81-year-old patient with difficult-to-heal venous leg ulcers of both lower limbs.

CASE REPORT

A 81 year old female patient (UK) was directed to the Clinical Department of Internal Diseases, Angiology and Physical Medicine in Bytom of the Medical University of Silesia in Katowice due to venous leg ulcers of both lower limbs, which according to the patient's report and received medical documentation were been present for about 6 months. The current outpatient treatment based mainly on the use of ointments, antibiotics and dressings did not give a fully satisfactory effect.

The medical interview also showed that the patient had been suffering from ischemic heart disease, permanent atrial fibrillation, heart failure, hypertension, mixed hyperlipidemia, chronic kidney disease and chronic venous insufficiency of the lower limbs for 11 years. At the same time, the patient denied the use of stimulants.

In physical examination, the patient was found to have skin ulcerations on the right and left shin with local inflammation of the surrounding tissues the ulcers, purulent secretions and slight pain ailments in the tissues around the ulcers on palpation (Figure 1). The patient's Body Mass Index (BMI) was 25 kg/m².



Figure 1. Local state of venous leg ulcers on the day of patient hospitalization – before the start of the magneto-LED therapy procedures

Before the start of the series of physical therapy procedures, the intensity of pain ailments associated with ulcerations assessed with use the 10-point VAS visual-analog scale was 5/6 points. This assessment concerned baseline pain ailments experienced in the last two weeks before hospitalization.

During hospitalization, the patient underwent a surgical and angiological consultation. The consulting angiologist stated: "There are numerous stenoses in the venous system of the lower limbs. The picture shows signs of venous insufficiency, the presence of inefficient perforators. There were no features of deep vein thrombosis of the lower limbs. The image of arterial vessels also shows numerous stenoses bearing signs of atherosclerotic changes".

Due to the presence comorbidities and the increased risk of disturbances in the proper healing process of persistent ulcerations in the patient, in addition to the implemented conventional pharmacological treatment of chronic venous insufficiency (acetylsalicylic acid, acenocumarol, Vessel Due F) and daily compression therapy, magneto-LED therapy were included.

THE PHYSICAL TREATMENT PROCEDURE

Physical procedures were performed using the Viofor JPS Standard apparatus (Med & Life, Poland) operating in the Magnetic & Light mode. Two-section panel applicators were used which, as part of the M2P2 therapeutic program (M2 – application with increasing intensity throughout the procedure, P2 – an option of the JPS system with two types of pulses using the phenomenon of ion cyclotron resonance) emitted a variable magnetic field with an intensity of 8 (average value of magnetic field induction 250 μ T) on a 12-point scale and low-energy optical radiation in the infrared range with a wavelength of 855 nm (average value of surface energy density 8.11 J/cm²) and red 630 nm (average value of surface energy density 1.64 J/cm²).

The treatments were performed on the area ulceration, non-contact, at a distance of about 5 cm from the irradiated skin surface, twice a day for 15 days with breaks on Saturdays



Figure 2. Magneto-LED therapy procedures in patients with use a panel applicators



Figure 3. Local state of the right lower leg after the completion of a 3-week cycle of magneto-LED therapy procedures (a total of 30 procedures).



Figure 4. Local state of the left lower leg after the completion of a 3-week cycle of magneto-LED therapy procedures (a total of 30 procedures)

and Sundays (Figure 2). The treatment time of single procedures was 12 minutes.

After each procedure, wounds (ulcers) were protected with Aquacel Ag Extra (ConvaTec, Reading, Berkshire, UK) dressings composed of sodium carboxymethyl cellulose fibers with the addition of 1.2% ionic silver, which enabled antibacterial activity and helped to clean the ulcer. Between physiotherapeutic procedures, compression therapy with the use of a Codoban bandage (Tricomed, Lodz, Poland) (compression class 2) was applied to each limb for 6-7 hours a day.

After the first seven days the therapeutic cycle, the patient reported a significant reduction intensity of pain ailments. There was also a significant decrease in the intensity of inflammation in the tissues surrounding the ulceration and the amount of purulent secretion, as well as intensive granulation of the wound which promoted the activation of the ulcer healing process.

After the end of the therapeutic cycle (3 weeks), the ulceration on both lower legs was completely healed (Figures 3, 4). At the same time, the patient reported almost complete relief of pain ailments (1 point in the VAS scale).

DISCUSSION

Disorders of the healing process of chronic wounds are still a significant medical problem in worldwide [6, 10, 11]. Despite the intensive development of medicine and the identification of many factors responsible for the abnormal course of healing processes, in many cases the possibilities of their full recovery remain limited. Currently available pharmacological treatment of lower leg ulcers is not fully effective. In many cases, it is long-term and burdensome for patients and in resistant cases, systemic infections, disability associated with the need to amputate a limb and even death of patients occur [6, 12, 13]. Modern

physical medicine treatments, used as part of comprehensive therapeutic programs in many cases allow for a significant improvement the effectiveness treatment of hard-to-heal wounds, including lower leg ulcers [2, 14, 15].

Clinical research on the therapeutic use of variable magnetic fields and low light energy in medicine has been conducted for over 30 years [9, 10]. However, there are few studies presenting the results of the combined use of variable magnetic fields and light optical in combination therapy treatments. One of such a physical treatments is magneto-LED therapy used in the treatment of the described case. As a result of its use, the patient achieved complete healing of ulcers of both lower limbs as a result of its removal of necrotic tissues and the formation of new granulation tissue, as well as a reduction in the intensity of inflammation and exudation in the tissues surrounding the ulceration and reduction of congestion in the areas where the treatments were applied. It should be emphasized that magneto-LED therapy was used only for 3 weeks until complete ulceration of the leg ulcers, while the previously used conventional treatment did not show effectiveness for the previous 6 months. The daily use of specialist dressings and compression therapy was also important in the comprehensive treatment, which resulted from numerous current guidelines on the treatment of hard-to-heal wounds. It is also worth emphasizing that the improvement in the intensity of the ulcer healing process was accompanied by a virtually complete disappearance of the pain ailments intensity experienced by the patient.

As emphasized above, there are still few studies in the available literature on the use of variable magnetic fields in the treatment of venous leg ulcers. In their literature reviews from the available Cochrane Wounds Group, Central, Medline, Embase and Cinahl databases, the authors emphasize that the results of the few randomized clinical trials to date have

not provided reliable evidence for obtaining clear benefits from the use of therapy with the use of electromagnetic fields in the treatment of ulcers leg veins and that further research is needed in this area [16-18].

It is now known that synergistically applied physical stimuli trigger a number of biochemical and intracellular reactions, creating optimal conditions for accelerating the wound healing process by improving blood circulation in tissues and stimulating regenerative processes (stimulation of DNA replication processes and protein and collagen synthesis) and angiogenesis. These processes take place thanks to biostimulating effects that are observed at the cellular and tissue level, increasing local blood supply, improving the rheological properties of blood and increasing the production of collagen by fibroblasts. Thanks to the above effects, the oxygenation of tissues and their supply with nutrients is increased, which leads to an improvement in the effectiveness of the epidermis process, intensification of angiogenesis and acceleration of healing processes [11, 19].

The participation of the above mechanisms was confirmed, among others, by in two papers in which the authors assessed the effectiveness of polarized light therapy and pulsed electromagnetic field therapy in a group of 45 patients with venous leg ulcers. The results of the first study showed that both pulsed electromagnetic field and polarized light therapy were effective in accelerating the healing of venous ulcers [20].

In the second study, in which 40 patients with venous leg ulcers were treated with laser light therapy, 82 ulcers with an average duration of 1 to 5 years were assessed during 1066 nursing consultations and a significant improvement in the

effectiveness of the ulcer healing process was confirmed as a result of using this physical method [21].

In another study, the authors obtained a positive effect of using magneto-LED therapy treatments in the case of a non-healing wound after knee joint surgery [22].

The effectiveness of magneto-LED therapy treatments was also confirmed in the treatment of a hard-to-heal wound after a mechanical injury in the lower leg area, where use this method of physical combined therapy the wound was healed, the intensity of inflammation of the tissues surrounding the wound was reduced and the pain subsided [23].

In medicine, physical methods are one of the oldest and natural methods of treatment, although their potential is not fully used. The effectiveness of these methods depends to a large extent on the type of disease, severity and duration of the lesions and above all on the early start and systematic conduct of treatments and strict adherence to the therapist's recommendations by the patient. It is to be hoped that further clinical trials involving larger groups of patients will allow for the introduction of e.g. magneto-LED therapy for comprehensive treatment programs for hard-to-heal wounds, including chronic leg ulcers.

CONCLUSIONS

The use of magneto-LED therapy procedures in the described case resulted in complete healing of leg ulcers and a significant reduction of pain intensity. It seems that the use of magneto-LED therapy in the complex treatment of hard-to-heal leg ulcers of venous etiology may bring significant therapeutic benefits, but confirmation of this results requires research on a larger research group.

References

1. Lawrence PF. Venous appropriate use criteria are an important step in improving the quality of chronic venous disease care. *J Vasc Surg Venous Lymphat Disord.* 2020; 8(4):499-500.
2. Gethin G, Probst S, Stryja J, Christiansen N, Price P. Evidence for person-centered care in chronic wound care: A systematic review and recommendations for practice. *J Wound Care.* 2020;1(29):1-22.
3. Materiały z 28 Konferencji PTLR (Polish Wound Management Association). Kraków, 2018.
4. Sopata M, Jawień A, Mrozikiewicz-Rakowska B et al. Guidelines for local management of uninfected wounds, wounds at risk of infection and infected wounds – An overview of the available antimicrobial substances used in the treatment of wounds. Recommendations of the Polish Wound Treatment Society. *Wound Treatment.* 2020;17(1):1-21.
5. Bonkemeyer Millan S, Gan R, Townsend PE. Venous Ulcers: Diagnosis and Treatment. *Am Fam Physician.* 2019;100(5):298-305.
6. Lindholm Ch, Searle R. Wound management for the 21st century: combining effectiveness and efficiency. *Int Wound J.* 2016; 13(2): 5-15.
7. Wachowski M, Fornalczyk-Wachowska E, Kuliński W. Selected physical Therapy methods in the Treatment of Lower Leg Ulceration. *Acta Balneol.* 2016;3(145):159-163.
8. Sieroń A, Pasek J, Mucha R. Pole magnetyczne i energia światła w medycynie i rehabilitacji – magnetoledoterapia. [Magnetic field and light energy in treatment and rehabilitation – magnetoledotherapy]. *Balneol Pol.* 2007;1(107):1-7. (in Polish).
9. Deruelle F. The different sources of electromagnetic fields: Dangers are not limited to physical health. *Electromagn Biol Med.* 2020;39(2): 166-175.
10. Sieroń A, Cieślak G, Stanek A. (red.): Pola magnetyczne i światło w medycynie i fizjoterapii. α-medica press. Bielsko-Biała 2013. (in Polish).
11. Melekhovets OK, Kharchenko TO, Orlovskiy VF et al. Treatment peculiarity of the Chronic Trophic Ulcers with Different pathogenic mechanism. *Acta Balneol.* 2020;1(159):12-16.
12. Kucharzewski M, Szkiler E, Krasowski G et al. Algorytmy i wytyczne postępowania terapeutycznego w ranach trudno gojących się. [Algorithms and guidelines for therapeutic management in non-healing wounds]. *Forum Leczenia Ran.* 2020;1(3): 95-116. (in Polish).
13. Haalboom M. Chronic Wounds: Innovations in diagnostics and therapeutics. *Curr Med Chem.* 2018;25(41):5772-81.
14. Pasek J, Stanek A, Pasek T, Sieroń A. Medycyna fizykalna szansą na poprawę stanu zdrowia pacjentów z chorobami naczyń krwionośnych. [Physical medicine as an opportunity for improving the health state of patients with vascular diseases (angiopathies)]. *Acta Angiol.* 2012;18(3):93-98. (in Polish).

15. Pasek J, Pasek T, Sieroń A, Cieślak G. Physical therapy in practical physiotherapist – innovative treatments, new equipment. *Rehabil in Prakt.* 2020;3:20-9.
16. Fernandez-Guarino M, Bacci S, Perez Gonzalez LA et al. The Role of Physical Therapies in Wound Healing and Assisted Scarring. *Int J Mol Sci.* 2023;24(8): 487.
17. Team V, Chandler PG, Weller CD. Adjuvant therapies in venous leg ulcer management: A scoping review. *Wound Repair Regen.* 2019;27(5):562-590.
18. Bouguettaya A, Gethin G, Probst S et al. How health literacy relates to venous leg ulcer healing: A scoping review. *PLoS One.* 2023;18(1): e0279368.
19. Ponikowska I, Kochański W. (red): *Wielka Księga Balneologii, Medycyny Fizykalnej i Uzdrowiskowej. Tom I*; Wydawnictwo Aluna, 2017.
20. Shaima AA, Zizi MI, Mohamady HM. Polarized light versus pulsed electromagnetic field therapy on healing of venous ulcers. *Int J Chem Tech Res.* 2017;10(5):427-34.
21. Bavarescol T, Fátima Lucena A. Low-laser light therapy in venous ulcer healing: a randomized clinical trial. *Rev Bras Enferm.* 2022;75(3):1-7.
22. Pasek J, Pasek T, Sieroń A. Magnetoledtherapy in the treatment of wounds after surgical procedures of the knee joint. *Ther Clin Risk Manag.* 2014;10:717-20.
23. Pasek J, Pasek T, Białkowska M, Cieślak G. Magnetoledoterapia w leczeniu rany podudzia po urazie mechanicznym – opis przypadku. [Magnetoledtherapy in the treatment of traumatic wound of leg ulcer – case report]. *Pielęgn Chir Angiol.* 2021;2:77-80. (in Polish).

ORCID AND CONTRIBUTIONSHIP*Grzegorz Cieślak: 0000-0003-2210-8744^{A-F}Jarosław Pasek: 0000-0001-6181-337X^{A-F}**CONFLICT OF INTEREST**

The Authors declare no conflict of interest

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A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review,

F – Final approval of the article

VARIA

KURS BALNEOLOGICZNY DOSKONALĄCY DLA LEKARZY 2023 R.

Na przełomie maja i czerwca bieżącego roku zorganizowaliśmy kolejny kurs balneologiczny dla lekarzy. Tematyka kursu: "Balneologia i medycyna fizykalna – metody lecznicze oraz wybrane problemy z medycyny uzdrowiskowej" Jest to już 24 kurs balneologiczny dla lekarzy przeze mnie organizowany.

Obecny kurs odbył się w dniach 29.05-9.06. 2023 w sanatorium St. George w Ciechocinku. Program obejmował 80 godzin zajęć dydaktycznych w tym 76 godzin wykładowych i 4 godziny ćwiczeń w zakładzie balneologicznym. W części praktycznej lekarze sami przyjmowali zabiegi balneologiczne i fizykoterapeutyczne oraz śledzili technikę ich wykonywania, dzięki temu mogli na sobie wypróbować ich działanie.

Celem całego 2-tygodniowego szkolenia było zapoznanie lekarzy pracujących w uzdrowiskach lub innych ośrodkach leczniczych z podstawowymi problemami balneologicznymi i uzdrowiskowymi. Wykłady prowadzone na wysokim poziomie miały zainspirować do dalszej nauki w zakresie medycyny uzdrowiskowej. Znaczna część uczestników nie pracowała jeszcze w uzdrowisku, ale deklarowała chęć w najbliższej przyszłości podjęcia pracy w polskich uzdrowiskach, inni już pracują ale chcieli pogłębić swoją wiedzę. Kilka osób miało rozpoczętą specjalizację z balneologii i medycyny fizykalnej. W kursie wzięło udział 46 lekarzy z całej Polski, w tym m.in. z Bydgoszczy, Torunia, Lublina, Jeleniej Góry, Buska Zdroju, Łańcuta, Krakowa, Warszawy, Ustronia, Szczecinka, Wielbarka, Tarnowa, Dusznik, Dębicy, Tomaszowa Lubelskiego, Siennej, Pruszczu Gdańskiego, Białegostoku, Łodzi, Świdnika, Radłowa, Nieborowic, Sycowa, Poznania i innych. Reprezentowali oni prawie wszystkie kliniczne specjalizacje lekarskie. Charakterystyczną cechą tego kursu była duża rozpiętość wieku uczestników od lekarzy dojrzałych do młodych.

Kurs obejmował zagadnienia podstawowe z zakresu geologii uzdrowiskowej, klimatologii, balneochemii, wskazań i przeciwwskazań do leczenia uzdrowiskowego, oraz omówienie wybranych dziedzin klinicznych w aspekcie uzdrowiskowym, jak: ortopedia, reumatologia, nadciśnienie tętnicze, kardiologia, geriatryka i gerontologia, hepatologia, diabetologia, i inne tematy kliniczne. Ponadto zapoznano uczestników z najważniejszymi metodami stosowanymi w leczeniu uzdrowiskowym, jak: balneohydroterapia, peloidoterapia, balneogazoterapia, hydroterapia, kinezyterapia, ciepło- i zimnolecznictwo, ultrasonoterapia, magnetoterapia, laseroterapia, elektroterapia. Na tym kursie uczestnicy mieli szansę spotkania się z Krajowym Konsultantem w dziedzinie Balneologii i Medycyny Fizykalnej.



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Pozwoliło to na poznanie zagadnień organizacyjnych uzdrowisk polskich oraz możliwość zadania pytań odnośnie do dalszego kierunku rozwoju leczenia uzdrowiskowego. Poza wykładami pokazano uczestnikom typowy zakład przyrodolecznicy, gdzie stosowane są omawiane procedury lecznicze. Do prowadzenia wykładów zaproszono wybitnych specjalistów, którzy od wielu lat z nami współpracują. Są to najczęściej pracownicy naukowo- dydaktyczni mający równocześnie specjalizację kliniczną i balneologiczną.

Na zakończenie kursu uczestnicy zobowiązani byli do zdania testu obejmującego 42 pytania jednorazowego wyboru z tematów zaprezentowanych na kursie. Wszyscy uczestnicy test zdali z wynikiem dobrym i bardzo dobrym, a 2 osoby z wynikiem celującym odpowiadając prawidłowo na wszystkie 42 pytania.

Z satysfakcją podkreślam, że wszyscy uczestnicy wykazywali duże zainteresowanie, pilnie korzystali z zajęć dydaktycznych, po wykładach odbywała się ożywiona dyskusja. Uczestnicy kursu mieli też szansę na zakupienie



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od wydawcy dwutomowego podręcznika – Wielka Księga Balneologii, Medycyny Fizycznej i Uzdrawiskowej, dzięki temu będą mogli wiedzę nabytą na kursie utrwalić i poszerzyć. Zgodnie z opinią lekarzy kurs był na bardzo wysokim poziomie, miał charakter interdyscyplinarny. Wielu uczestników było zdziwionych, że medycyna uzdrawiskowa obejmuje tak szeroki, interdyscyplinarny zakres wiedzy medycznej. Część lekarzy uczestniczących w kursie deklarowała chęć pogłębienia wiedzy w ramach specjalizacji z balneologii i medycyny fizycznej, chociaż wcześniej tego nie planowali oraz uczestniczenia w kongresach balneologicznych. Dużą zaletą tego kursu była forma kontaktowa, „na żywo”. Pozwoliło to na szeroką dyskusję między lekarzami i z wykładowcami oraz nawiązanie kontaktów.

W czasie trwania kursu panowała koleżeńska pełna życzliwości atmosfera. Wybrana przez lekarzy Starościna doskonale współpracowała z organizatorami kursu, pracowała wytrwale nad integracją grupy, co się wspaniale udało. Przed wyjazdem do domów wszyscy wymienili się adresami celem kontynuacji znajomości i współpracy. Kurs zakończono wykonaniem zdjęcia rodzinnego, który załączam

Dziękuję wszystkim uczestnikom i wykładowcom za zaangażowanie i wytworzenie koleżeńskiej atmosfery, a zwłaszcza staroście Pani dr Oldze Kolodiy

**Kierownik naukowy kursu
Prof. dr hab. Irena Ponikowska**

SPRAWOZDANIE Z I OGÓLNOPOLSKIEJ KONFERENCJI NAUKOWEJ „DYSCYPLINY KOMPLEMENTARNE FIZJOTERAPII” ABNS W BIAŁEJ PODLASKIEJ 25-26.05.2023

Monika Kadłubowska, Joanna Baj-Korpak, Kamil Zaworski



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W dniach 25-26 maja 2023 r. w Białej Podlaskiej odbyła się I Ogólnopolska Konferencja Naukowa „DYSCYPLINY KOMPLEMENTARNE FIZJOTERAPII”. Organizatorem tego wydarzenia był Zakład Fizjoterapii Akademii Białskiej Nauk Stosowanych im. Jana Pawła II. Honorowy patronat nad konferencją objął JM Rektor ABNS w Białej Podlaskiej prof. dr hab. Jerzy Nitychoruk, natomiast patronat medialny czasopismo Acta Balneologica.

Komitet Naukowy:

Przewodnicząca:

dr hab. Elżbieta Rutkowska – Akademia Bialska Nauk Stosowanych im. Jana Pawła II

Członkowie:

prof. dr hab. Krystyna Chmiel – Akademia Bialska Nauk Stosowanych im. Jana Pawła II

prof. dr hab. Janusz Kirenko – Uniwersytet Marii Curie Skłodowskiej w Lublinie

prof. dr hab. Robert Latosiewicz – Uniwersytet Medyczny w Lublinie

prof. dr hab. Igor Mysuła – Akademia Bialska Nauk Stosowanych im. Jana Pawła II

dr hab. Mariusz Drużbicki – Akademia Bialska Nauk Stosowanych im. Jana Pawła II

dr hab. Krystyna Gawlik – Akademia Bialska Nauk Stosowanych im. Jana Pawła II

dr Anna Krawczyńska – Uniwersytet Medyczny w Lublinie
dr n. med. Rafał Sapuła – Prezes Polskiego Towarzystwa Rehabilitacji

dr Ireneusz Hałas - IREHA – Centrum Medyczne Fizjoterapii i Fizjoprofilaktyki w Lublinie

Komitet Organizacyjny:

Przewodnicząca:

dr Joanna Baj-Korpak – Akademia Bialska Nauk Stosowanych im. Jana Pawła II

Członkowie:

dr Anna Pańczuk – Akademia Bialska Nauk Stosowanych im. Jana Pawła II

dr Tomasz Senderek – Uniwersytet Medyczny w Lublinie

dr Teresa Stawińska – Uniwersytet Medyczny w Lublinie



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dr Kamil Zaworski – Akademia Bialska Nauk Stosowanych im. Jana Pawła II

mgr Monika Kadłubowska – Akademia Bialska Nauk Stosowanych im. Jana Pawła II

mgr Renata Rzeczowska – sekretarz - Akademia Bialska Nauk Stosowanych im. Jana Pawła II

Otwarcia konferencji wraz ze słowem wprowadzającym dokonała przewodnicząca Komitetu Naukowego dr hab. Elżbieta Rutkowska wraz JM Rektorem prof. dr hab. Jerzym Nitychorukiem.

Obrady rozpoczęto sesją plenarną, na którą złożyły się cztery wystąpienia:

prof. dr hab. Janusz Kirenko – Uniwersytet Marii Curie Skłodowskiej w Lublinie „DZIAŁALNOŚĆ TWÓRCZA OSÓB Z NIEPEŁNOSPRAWNOŚCIĄ”

prof. dr hab. Robert Latosiewicz – Uniwersytet Medyczny w Lublinie „BIOLOGICZNE MECHANIZMY LECZENIA BALNEOKLIMATYCZNEGO”

dr hab. Mariusz Drużbicki prof. Uczelni – Akademia Bialska Nauk Stosowanych im. Jana Pawła II „HEG NEUROFEEDBACK W REHABILITACJI RĘKI OSÓB PO UDARZE”

lek. wet. Radosław Fedaczyński – Lecznica dla zwierząt „ADA” w Przemyślu „REHABILITACJA ZWIERZĄT W PRAKTYCE WETERYNARYJNEJ” – połączenie online

Równocześnie trwała również wystawa obrazów prof. dr hab. Janusza Kirenki.

Pierwszego dnia w dwóch sesjach naukowych zaprezentowano referaty, w których autorzy krajowi jak i zagraniczni (Ukraina) poruszyli wiele tematów m.in. dietytyki, rehabilitacji pacjentów z przewlekłym bólem, postaw społecznych studentów z Polski i Ukrainy wobec osób poruszających się na wózkach, wsparciu matek dzieci z niepełnosprawnością, robotyki w rehabilitacji i in. Po każdej sesji naukowej był czas na dyskusję i rozmowy,

podczas których zwrócono uwagę na wysoki poziom zaprezentowanych referatów.

Po zakończeniu sesji naukowych, uczestnicy konferencji mogli wziąć udział w jednym z trzech zaproponowanych warsztatów:

Arteterapia rozwojowa i kliniczna – prowadzący mgr Tomasz Kuta, Centrum Pedagogiki i Psychologii Politechniki Krakowskiej

Zooterapie jako innowacyjne metody pracy – prowadząca dr inż. Elżbieta Horoszewicz, Uniwersytet Przyrodniczo-Humanistyczny w Siedlcach

Trening medyczny w bólach przewlekłych kręgosłupa – prowadzący mgr Sebastian Krawczyk, MOVE FOR HEALTH

Pierwszy dzień konferencji zakończył się uroczystą kolacją, na którą zaproszono wszystkich uczestników konferencji. To spotkanie towarzyskie było okazją do podjęcia wymiany myśli oraz zacieśnienia więzów międzyuczelnianych.

Następnego dnia obrad odbyły się dwie sesje – naukowa oraz plakatowa. Podczas sesji naukowej poruszone były tematy z zakresu zooterapii, animaloterapii, hipoterapii, alpakoterapii, rehabilitacji pacjentów w wodzie, wpływu komunikatów głosowych na aktywację mięśni oraz wiele innych tematów.

W trakcie sesji plakatowej zaprezentowano ponad 20 posterów, których autorzy omawiali problemy terapeutyczne w wybranych przez siebie przypadkach. W wymianie poglądów oraz doświadczeń z zakresu fizjoterapii, zooterapii, psychologii, pedagogiki, arteterapii uczestniczyli przedstawiciele Uczelni Medycznych, Uniwersytetu Szczecińskiego, Uniwersytetu Warmińsko-Mazurskiego, Uniwersytetu Przyrodniczo-Humanistycznego w Siedlcach, National Technical University of Ukraine oraz praktycy z kraju i z zagranicy.

Na koniec obrad głos zabrał również przedstawiciel Krajowej Izby Fizjoterapeutów Pan mgr Bartłomiej Borowiec, który w bardzo miłych i ciepłych słowach wypowiedział się o konferencji oraz wyraził nadzieję na kontynuację tego wydarzenia. Oficjalnego podsumowania i zakończenia obrad dokonała przewodnicząca komitetu naukowego dr hab. prof. uczelni Elżbieta Rutkowska.

Należy zaznaczyć, że konferencja „Dyscypliny Komplementarne Fizjoterapii” mogła odbyć się dzięki dofinansowaniu ze środków budżetu państwa w ramach programu Ministra Edukacji i Nauki pod nazwą „Doskonała Nauka” nr projektu DNK/SP/549325/2022 – kwota dofinansowania 49 225,00 zł, całkowita wartość projektu 67 525,00 zł. Ogromnym wsparciem wydarzenia byli również wystawcy oraz promujące naszą Konferencję czasopisma i wydawnictwa: Sztuka Leczenia, FizjoActiv, MedenInMed, Technomex, BTL, Astar, EgzoTech, Wydawnictwo ABNS w Białej Podlaskiej, Wydawnictwo ALUNA.

Wszystkim prelegentom oraz licznie przybyłym słuchaczom w imieniu organizatorów konferencji serdecznie dziękujemy.

Do zobaczenia na kolejnych obradach!

KONFERENCJE, SYMPOZJA

„FIZJOTERAPIA W DOBIE ZMIENIAJĄCEGO SIĘ ŚWIATA”

W dniach 2-3 czerwca 2023 r. w Suścu w woj. lubelskim odbyła się XI Konferencja Naukowo – Szkoleniowa pt. "Fizjoterapia w dobie zmieniającego się świata" organizowana przez firmę Eres Medical wspólnie z Oddziałem Lubelskim Polskiego Towarzystwa Fizjoterapii oraz Oddziałem Lubelskim Stowarzyszenia Fizjoterapia Polska. Patronat medialny czasopismo naukowe „Acta Balneologica”.



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Konferencja poświęcona była wyzwaniom fizjoterapii w obliczu wszechobecných zmian zachodzących na świecie, takich jak pędzący postęp technologiczny oraz szybkie tempo życia dzisiejszego społeczeństwa.

Wykład wprowadzający zaprezentowała prof. dr hab.n.med. Małgorzata Łukowicz, Krajowy Konsultant w dziedzinie rehabilitacji. Na konferencji swoją obecność zaznaczyli również dr n.med. Rafał Sapała, prezes Polskiego Towarzystwa Rehabilitacji, dr hab. Alicja Wójcik-Załuska, Konsultant Wojewódzki w dziedzinie fizjoterapii dla woj. lubelskiego



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oraz wiele innych autorytetów z dziedziny rehabilitacji i fizjoterapii.

W wydarzeniu uczestniczyło ponad 100 fizjoterapeutów z województwa lubelskiego i ościennych. Przy okazji odbyła się również wystawa sprzętu do fizjoterapii.

M.L.



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