

# Features of Physical Therapy of People with Endocrine System Pathology

## Elementy fizykoterapii osób z chorobami endokrynologicznymi

DOI: 10.36740/ABAL202202106

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### SUMMARY

**Aim:** To check the effectiveness of the program of physical therapy of patients with type 1 diabetes.

**Materials and Methods:** The study involved 30 people (25-35-year-old women) with type 1 diabetes of moderate severity of the disease in the subcompensation stage, who were at the sanatorium stage of treatment. Patients, along with following a diet and insulin therapy, were engaged in physical exercises according to the author's program based on the Nordic Walking. Assessment of the impact of physical rehabilitation was performed on blood sugar level, heart rate, blood pressure.

**Results:** It is established that at the end of the experiment the blood sugar level of the EG patients significantly ( $p \leq 0.05$ ) decreased by 0.8 mmol/l (7.54%), in contrast to CG, where the difference is 0.3 mmol/l (2.75%) and is unreliable ( $p \geq 0.05$ ). This indicates the effectiveness of the developed program of physical therapy for diabetic patients based on Nordic Walking classes in combination with traditional methods of treatment.

**Conclusions:** Nordic Walking classes for patients with type 1 diabetes help to increase insulin sensitivity, stabilize blood pressure, reduce the risk of developing coronary heart disease, increase immunity, expand the functional capabilities of the body, improve the well-being and psychoemotional state of patients.

**Key words:** physical therapy, diabetes, physical exercises, Nordic Walking

**Słowa kluczowe:** fizjoterapia, cukrzyca, ćwiczenia fizyczne, Nordic Walking

Acta Balneol, TOM LXIV, Nr 2(168);2022:133-137

### INTRODUCTION

Type 1 diabetes mellitus or insulin-dependent diabetes is an endocrine pathology that most often occurs among under 30-40-year-old people. Type 1 diabetes is a severe somatic disease, the treatment of which requires strict diet, regular insulin therapy, exercise and mandatory medical supervision [1, 2]. Diabetes mellitus leads to early disability, mortality due to vascular complications, myocardial infarction, stroke, gangrene of the lower extremities and other complications [3].

The statistics show that more than 100 million people suffer from diabetes worldwide and in the future, despite the achievements of diabetology, scientists predict an increase of the incidence of diabetes. On average the number of patients doubles every 15 years [4]. Research [5, 6] show that in economically developed countries, the incidence

of diabetes is 1.5-4% among the population. With age, the incidence of the disease increases, reaching 7-8% among people over 55 years old. Diabetes among obese people is 6-10 times more common than among people with normal body weight [7]. As of 1.01.2015, the number of registered patients with diabetes in Ukraine reached 1.221.300 people, which is 2.667.6 per 100 thousand of population. There is an increase in the prevalence of diabetes in Ukraine by 22% from 2010 to 2015. There is also a significant increase in the number of new registered cases of diabetes among the population of Ukraine: by 23.7% over the past 5 years [8].

Physical therapy is of great importance in the treatment of this disease. Specialists [9] define three main areas of physical therapy for diseases: motor activity, diet and insulin therapy. According to scientists [10] combining insulin with exercise

leads to a more effective reduction in blood sugar levels. Therapeutic physical culture has a beneficial effect on the body of a person suffering from diabetes. With proper training and constant monitoring by a doctor, you can get rid of not only the side effects of the disease (metabolic disorders, obesity, etc.), but also normalize blood sugar. Also, physical therapy for diabetes stimulates tissue and muscle metabolism, reduces body weight, improves digestion, increases the absorption and consumption of sugar by muscles, increases the activity of enzymes responsible for the formation of energy from glucose, normalizes the acid-base balance [11, 12]. All this helps to reduce blood sugar and increase the body's tolerance to carbohydrates.

### AIM

The aim is to check the effectiveness of the program of physical therapy of patients with type 1 diabetes.

### MATERIALS AND METHODS

The study involved 30 people (25-35-year-old women) with 1 type diabetes of moderate severity of the disease in the subcompensation stage, who were at the sanatorium stage of treatment. The study participants were divided into two equal groups – experimental (EG) and control (CG), including 15 women each. The research was conducted on the basis of the sanatorium “Berezovyi Hai” (Khmilnyky, Ukraine) in 2020. The results were processed at the Department of Biology, Human Health and Physical Rehabilitation of Berdyansk State Pedagogical University (Berdyansk, Ukraine). Patients of CG were treated with strict adherence to the developed diet and regular insulin therapy without performing physical exercises according to the traditional program of a health-improving institution. Patients of EG, in addition to the listed methods of treatment, were engaged in physical exercises according to the program based on Nordic Walking (the duration of each class is 40 minutes). The number of classes per week is 5. The duration of the course of physical rehabilitation is 3 weeks. Assessment of the impact of physical rehabilitation means was carried out according to the following indicators: blood sugar level, heart rate, blood pressure. The results of previous studies of patients of EG and CG showed that each of the patients had a significant increase in blood sugar levels, heart rate and blood pressure fluctuated within the normal range. There were no significant differences in blood sugar, heart rate and blood pressure among patients in both groups.

The research methods: theoretical (analysis and generalization of literature (22 sources from the databases Scopus, PubMed, Web of Science Core Collection were analyzed), sociological methods (study of case histories), medical and biological methods (determination of blood sugar level), pedagogical observations, experiment, methods of mathematical statistics (statistical analysis was performed using Student's t-test). This study followed the regulations of the World Medical Association Declaration of Helsinki – ethical principles for medical research involving human subjects. Informed consent was received from all individuals who took part in this research.

### RESULTS

Analysis of existing physical therapy programs for patients with type 1 diabetes showed that the aim of physical therapy is to reduce blood sugar level and improve the quality of life, but traditional means of physical rehabilitation do not effectively affect the compensation of the disease, so we developed a physical therapy program in which, in addition to traditional means of therapeutic physical culture, Nordic Walking was used. Nordic Walking is very easy to perform, and improving overall well-being, increasing muscle performance helps to avoid complications, increase performance, while not causing physical overload. The objectives of the author's program have been defined as: achieving compensation for diabetes (reducing the use of insulin dose); increasing muscle tone and performance; normalization of body weight; prevention of acute and chronic complications in diabetes mellitus; improving the psychoemotional state; improving the activity of the central nervous system; activating blood and lymph circulation in the extremities, redox and metabolic processes; stimulating the functions of the cardiovascular, respiratory and digestive systems; stimulating the functions of the pancreas, activating metabolism; increasing body tone and muscle performance.

The author's program included morning hygienic gymnastics and Nordic Walking. Morning exercises were performed after sleeping in the open air, with musical accompaniment. The main tasks of morning exercises were: waking up the body after sleep, raising the overall tone of the patient, bringing the body to a cheerful state. Complexes of morning hygienic gymnastics consisted of general development exercises, exercises with objects (Nordic sticks). Duration is 15 min. One of the advantages of Nordic Walking is the simple and natural technique of its implementation and unpretentiousness to the place and conditions of holding. The back is straight, the shoulders are straight and free. The movements are the same as with normal walking: the right leg and left arm work simultaneously, and vice versa. It must be remembered that hands with sticks in Nordic walking are not a support, but engines. Focusing on the stick and pushing it makes walking more rhythmic and energetic. The hand should be squeezed around the stick when the hand goes forward, and unclenched when the hand goes back; the foot should be lowered first on the heel, then on the toe.

The results of the study of blood sugar, heart rate and blood pressure (systolic and diastolic) indicators among patients with EG and CG during the experiment period are presented in Table 1.

The blood sugar level among patients with both EG and CG before rehabilitation measures was higher than normal among each of the patients, and the average value at the beginning of the study was 10.9 mmol/l in CG and 10.6 mmol/l in EG. Upon repeated examination, this indicator decreased unreliably in CG by 0.3 mmol/l (2.75%,  $p \geq 0.05$ ), and in EG – reliably by 0.8 mmol/l (7.54%,  $p \leq 0.05$ ). That is, after carrying out rehabilitation measures in accordance with the program of the health-improving institution, there were

**Table 1.** Dynamics of indicators of patients with type 1 diabetes before and after rehabilitation measures (Mean±SD, n = 30)

Groups	Stages of the experiment		Increase, %	t	p
	Before	After			
	Blood sugar level, mmol/l				
EG	10.6±0.3	9.8±0.2	7.54 %	2.02	≤0.05
CG	10.9±0.4	10.6±0.3	2.75 %	0.60	≥0.05
	Heart rate, beats/min				
EG	78.6±1.2	78.7±1.1	0.12 %	0.06	≥0.05
CG	78.1±1.4	78.2±1.3	0.12 %	0.05	≥0.05
	Blood pressure systolic, mm Hg				
EG	122.5±1.9	121.8±1.7	0.57%	0.27	≥0.05
CG	121.5±1.7	121.6±1.6	0.08%	0.04	≥0.05
	Blood pressure diastolic, mm Hg				
EG	82.2±1.8	80.8±1.6	1.70%	0.58	≥0.05
CG	81.5±1.6	81.2±1.6	0.37%	0.13	≥0.05

Legend: Mean – arithmetical average; SD - standard deviation; p – the significance of difference between the indicators of EG and CG due to the Student's t-test

no significant changes in blood glucose levels in the CG, and sugar levels in the EG significantly decreased, which indicates the effectiveness of Nordic Walking classes according to author's program. Moreover, Nordic Walking did not worsen the well-being of EG patients, which indicates that heart rate and blood pressure indicators remained within the normal range. The results of repeated testing of patients with EG and CG at the end of the experiment showed that minor changes in heart rate and blood pressure occurred in both groups, but in EG, unlike CG, they were more pronounced. So, the author's program had a more positive effect on reducing blood sugar on the functional parameters of the cardiovascular system and contributes to improving the level of health and well-being of women with type 1 diabetes.

## DISCUSSION

The XXI century has raised the problem of diabetes mellitus not only as a general biological problem, but also as a social one. This is due to the fact that this pathology ranks third (after atherosclerosis and cancer) among diseases that are the most common cause of disability and mortality [13]. In Ukraine, diabetes ranks second in the structure of endocrine diseases (31.88 %) after pathology of thyroid gland (46.67%) [8].

Scientists note that diabetes mellitus is an endocrine disease characterized by chronic hyperglycemia associated with absolute or relative insulin deficiency and develops due to the influence of various endocrine, immune, exogenous (stress, infection, smoking) factors or a combination of them [14]. This disorder is caused by a decrease in the production of the pancreatic hormone insulin. When this hormone is insufficient, the formation of glycogen decreases and the blood sugar content becomes higher than normal (hyperglycemia), and its utilization by tissues decreases and it begins to pass through the kidneys and is excreted in the urine. Among the main causes that lead to diabetes, scientists [2, 6, 7] distinguish: heredity, improper nutrition, obesity, chronic diseases, excessive alcohol consumption,

smoking, sedentary lifestyle, stress. Improper nutrition leads to the appearance of many diseases due to a decrease in the protective properties of the body, disrupts metabolic processes, leads to premature aging, reduced performance, weakens the body that is sensitive to negative influences [9]. Obesity is excessive deposition of fat, weight gain due to adipose tissue. According to the scientists [3, 5] the risk of developing diabetes due to obesity among women is much higher than among men, which is associated with the deposition of fat mass in the abdomen, waist, thighs.

The treatment of diabetes mellitus include the use of diet therapy to reduce carbohydrate intake. Diet therapy is an auxiliary measure and has an effective effect only in combination with insulin therapy. Diets and nutrition regime should be observed for all forms of diabetes mellitus and methods of its treatment [4, 8].

Therapeutic physical culture is a mandatory component of complex therapy in the treatment of diabetes mellitus. Dosed physical activity helps to regulate the mode of work and rest, which ensures a reduction of body weight to the optimal for an individual and control of energy consumption and energy expenditure [16]. Exercises stimulate skeletal muscle cells to apply more glucose from the blood, improves the state of the cardiovascular system, reduces the risk of disease, and also improves sleep, helps relieve depression and stress. Comparing physical activity with an additional dose of insulin, the scientists [17] note that physical exercises stimulate tissue and muscle metabolism, improve digestion; prevent the progression of atherosclerosis, maintain optimal blood circulation and respiration, normalize the emotional and mental sphere of the patient. The amount of physical activity plays an important role. It also matters at what indications of glucose in the blood the patient begins to exercise, what and how much he ate before, what is the body's readiness for exercise [18]. Experts believe that physical exercises involving large muscle groups at a slow and medium pace and with a significant number of repetitions cause an increase in oxidative processes in the muscles, so that not only glycogen is

consumed, but also glucose is consumed in the blood [10, 11]. Our program offered a combination of traditional methods of treating diabetes (diet and insulin therapy) and performing physical exercises based on Nordic Walking [19]. Nordic Walking, performed outdoors in forest and park areas, refers to active climate therapy. Active inhalation of clean fresh air saturated with phytoncides is provided, as a result of which the function of external respiration improves, and respiratory movements become deeper. The respiratory volume increases, and ventilation of the lungs improves. The respiratory act is rebuilt and becomes more effective. As a result, the oxygen pressure in the alveolar air increases and the blood saturation with it increases, which is called “oxygenation of the body” [20]. Unlike normal walking or running, the muscles of not only the legs and lower torso are involved, but also the muscles of the arms and upper torso, that is, almost all the muscles of the body, which leads to maximum activation of the so-called “muscle pump of the body”, which reduces the load on the heart. A sufficiently large amount of muscle activity combined with its low intensity allows you to effectively train the cardiovascular system, as a result of which heart function improves, heart rate stabilizes. Nordic Walking works 90% of the muscles, because it is known that physical activity increases the absorption of glucose by working muscles, reduces the level of glycemia and the need for insulin. It consumes 50% more calories than with normal walking, which effectively affects the reduction and stabilization of body weight, as well as prevention of obesity. In addition, Nordic Walking is easy to use and does not require special facilities, so diabetic patients can practice it independently in parks, streets, squares, etc. [20].

## CONCLUSIONS

1. The author’s program of physical therapy for patients with type 1 diabetes was developed, in which, in addition to traditional means of therapeutic physical culture, Nordic Walking was used. The main tasks of the author’s program were to achieve compensation for diabetes (reducing the use of insulin doses); normalize body weight; improve psychoemotional state; stimulate the functions of the cardiovascular, respiratory and digestive systems; activate metabolism; increase body tone and muscle performance. The duration of the course of physical rehabilitation is 3 weeks, the duration of each lesson is 40 minutes, the number of classes per week is 5.
2. The effectiveness of the developed program was tested and it was found that Nordic Walking classes in combination with traditional methods of treatment had a positive effect on reducing blood sugar levels among patients of EG. At the end of the experiment this indicator significantly improved among EG by 0.8 mmol/l (7.54%,  $p \leq 0.05$ ), in contrast to CG – the difference is 0.3 mmol/l (2.75%) and is unreliable ( $p \geq 0.05$ ).
3. It was found that Nordic Walking classes among patients with type I diabetes mellitus are manifested by an increase in insulin sensitivity, stabilization of blood pressure, increased blood flow in the coronary vessels of the heart, a decrease in the risk of developing coronary heart disease, increased immunity, expansion of the body’s functional capabilities, improvement of well-being and psychoemotional state.

Prospects for further research encompass evaluation of the effectiveness of the author’s program for physical therapy of older people (over 40 years old) with diabetes.

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*This study was carried out according to the plan of the research work of the Department of Biology, Human Health and Physical Rehabilitation of Berdyansk State Pedagogical University for 2018-2022 on the theme of "Formation of professional competence of the future specialist in physical rehabilitation" (state registration number 0116U008839).*

#### Conflict of interest:

The Authors declare no conflict of interest

**Received:** 22.06.2021

**Accepted:** 20.12.2021

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Info

### INFORMATION FOR DOCTORS

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

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

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

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

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

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

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

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