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Voitenko D.O.[1], Golovchenko I.V.[1], Tarasova O.O.[1], Morozenko D.V.[2], Danylchenko S.I.[1]

PHYSICAL ACTIVITY AND REHABILITATION STRATEGIES IN THE COMPREHENSIVE MANAGEMENT OF TYPE 2 DIABETES

[1]Kherson State University, Kherson–Ivano-Frankivsk, Ukraine
[2]State Institution "Sytenko Institute of Spine and Joint Pathology of the National Academy of Medical Sciences of Ukraine", Kharkiv, Ukraine

Type 2 diabetes mellitus is one of the most common non-communicable diseases worldwide and is linked to high risks of complications, disability, and reduced quality of life. Consequently, there is an increasing need for effective non-drug treatment options, especially physical rehabilitation and personalized physical activity. Aim. To summarize current scientific evidence on the role of physical activity and rehabilitation technologies in the comprehensive management of patients with Type 2 diabetes mellitus and to analyze the effectiveness of existing approaches considering clinical, functional, and age-related factors. Materials and Methods. An analytical review of 36 scientific publications from international databases (PubMed, Scopus, Web of Science) was conducted. The selected studies focused on the use of physical therapy in Type 2 diabetes mellitus, were of high methodological quality, and provided data on the effects of physical activity on metabolic, functional, and psycho-emotional indicators. Results. This article summarizes current approaches to the use of therapeutic exercise, kinesiotherapy, massage, hydrotherapy, diet therapy, and phytotherapy in the treatment of Type 2 diabetes mellitus. Special attention is given to the importance of individualized exercise programs based on disease compensation level, cardiovascular comorbidities, physical fitness, and coexisting conditions. It has been shown that moderate-intensity physical activity (60–75% HRmax) improves insulin sensitivity, reduces body weight, normalizes glycemia, and prevents complications. Emphasis is placed on the gradual increase in physical load, glycemic control before and after exercise, and the importance of psycho-emotional support. Conclusions. Integrating physical rehabilitation methods into the treatment of Type 2 diabetes mellitus significantly enhances therapy effectiveness, improves patients' quality of life, and reduces the risk of complications. A promising direction is the development of differentiated rehabilitation programs tailored to individual clinical and physiological characteristics.

Key words: glycemic control, complication prevention, kinesitherapy, cardiovascular risks, individualized load.

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Introduction

Diabetes mellitus is currently one of the most urgent medical and social issues not only in Ukraine but worldwide. It ranks among the most common severe chronic diseases, significantly affecting the quality of life and functional ability of the population.

According to estimates from the World Health Organization, the global number of people living with diabetes has increased from 200 million in 1990 to 830 million in 2022, representing approximately 2–3% of the world's population. It is projected that this number will triple every 15 years. As of 2023, the estimated global prevalence of diabetes among adults aged 20–79 is around 589 million people (about 10.5%), with a predicted rise to 853 million by 2050 [1, 2]. In Ukraine, the prevalence of diabetes is 2,463.9 per 100,000 people, with over 2 million officially registered cases [3]. The vast majority of these individuals are diagnosed with type 2 diabetes (T2DM).

Diabetic complications often result in reduced work capacity, lifestyle modifications, and loss of professional activity, highlighting the need for targeted medical and physical rehabilitation. In this context, health-promoting and rehabilitation strategies, such as therapeutic exercise, massage, hardening (exposure to natural stimuli), dietary therapy, and phytotherapy, play an increasingly important role in modern medicine. These interventions help improve cardiovascular function, reduce insulin resistance, and enhance the body's immune response, ultimately contributing to better disease management [4].

Therapeutic exercise (physical therapy) is an effective component of comprehensive diabetes management, but only when individualized - i.e., when physical activity is tailored to the specific course of the disease, the patient's functional capabilities, and the presence of complications [5, 6].

Aim of this study is to summarize current scientific evidence on the effectiveness of physical rehabilitation modalities in type 2 diabetes, including therapeutic exercise, kinesitherapy, and massage, as well as to determine their role in improving the clinical course of the disease, preventing complications, and enhancing patients' quality of life.

Materials and Methods

This study involved a generalization and analytical review of scientific literature concerning physical rehabilitation in patients with T2DM. A total of 35 scientific sources were analyzed, including publications from recent years found in international databases such as PubMed, Scopus, and Web of Science, as well as in relevant Ukrainian academic

journals.

The inclusion criteria for sources were: scientific novelty of the research; relevance to the topic of physical therapy and rehabilitation in T2DM; detailed descriptions of therapeutic exercise, kinesitherapy, adaptive physical activity, massage, and dietary therapy; and evidence of the impact of interventions on metabolic parameters, functional status, prevention of complications, and patient quality of life.

The methodological approach included elements of content analysis, comparative analysis of intervention effectiveness, and systematization of strategies for developing individualized physical therapy programs based on the clinical condition of patients with T2DM.

Results

Several researchers have examined various therapeutic exercise techniques for patients with T2DM mellitus and have demonstrated that participation in therapeutic physical activity leads to reduced blood glucose levels and insulin requirements. These interventions improve blood circulation in the heart and peripheral tissues, reduce body fat and overall weight, enhance immune function, and improve patients' psycho-emotional well-being [7, 8].

Within the scope of physiotherapeutic interventions, particularly therapeutic exercise, studies conducted by the Kharkiv Academy of Physical Culture showed that regular participation in physical therapy results in improved glycemic control and reduced insulin demand. Observed effects include increased insulin sensitivity, normalization of blood pressure, prevention of cardiovascular complications through improved microcirculation, a decrease in blood lipid levels (especially triglycerides), and an increase in HDL cholesterol. Furthermore, regular exercise leads to reductions in body weight and fat percentage, contributes to osteoporosis prevention, lowers erythrocyte adhesion (thereby reducing thrombosis risk), and improves both immune and psycho-emotional status, promoting better social adaptation of patients [9, 10].

In the classical concept of medical rehabilitation, it is emphasized that the physician must assess the course of the disease, the patient's general condition, the stage of the illness, age-specific characteristics, and functional reserve to select rehabilitation tools appropriately, determine the motor activity regimen, and define the sequence of therapeutic interventions.

Therapeutic exercise, massage, hardening procedures, diet therapy, and phytotherapy contribute to increased work capacity, improved cardiovascular function, mitigation of disease severity, and enhancement of immune function and overall body reactivity. It is important to note that therapeutic exercise is effective only when physical activity is prescribed with consideration of the disease progression and the functional capabilities of patients with T2DM [11, 12].

A systematic review and meta-analysis have confirmed that regular physical exercise improves insulin sensitivity in patients with T2DM mellitus, with the effect persisting for approximately 48–72 hours after the last training session [13]. A primary study further demonstrated that after seven consecutive days of intensive training, insulin sensitivity significantly increases; however, without continued exercise for 3–4 days, this effect markedly declines: "the short-lived effects … wear off in 3–4 days … frequent exercise is needed to maintain the beneficial effects" [14]. These findings indicate that a break in training longer than 2–3 days leads to a significant reduction in insulin sensitivity, thereby confirming the necessity of maintaining regular physical activity in the management of T2DM.

Moderate-intensity exercise (60–75% of maximum individual heart rate) is recommended in the form of walking, swimming, cycling, and other aerobic activities during the outpatient phase. Exercise prescriptions should consider disease compensation, glycemic status, and absence of angiopathies [15, 16].

For patients with T2DM, moderate physical activity (60–75% of individual maximal capacity) is advised. The American Diabetes Association (ADA) and the American College of Sports Medicine (ACSM) recommend at least 150 minutes per week of moderate-intensity aerobic activity (~40–60% VO_2max or 3–6 METs), distributed over ≥3 sessions per week, with no more than 2 days between sessions [17, 18].

Walking, swimming, and cycling are generally well tolerated. At this rehabilitation stage, activities such as walking on flat terrain, terrain cure routes, hiking excursions, and short-distance tourism are widely used. Physical activity should be prescribed only in the absence of pronounced angiopathies. The active movement program is best conducted during periods of natural blood glucose elevation, i.e., 20–25 minutes after meals [19]. The volume of physical activity is achieved by gradually increasing the duration of exercise over 10–15 weeks, usually by adding 5 minutes at a time, provided the patient feels well after each increment.

The structure of therapeutic physical culture (TPC) involves a gradual increase in volume and duration: +5 minutes every 1–2 weeks, aiming for a 10–15 week course with session durations of 30–45 minutes, 3–5 times per week. Before exercise, patients should eat 1–3 hours prior; during prolonged sessions, additional carbohydrate snacks are recommended every 30 minutes. Blood glucose should be monitored before and after exercise, and insulin doses adjusted accordingly for extended or intensive training sessions.

The prescription of physical exercises for elderly patients with comorbid cardiovascular conditions is implemented gradually: starting with simple forms of

physical activity in sitting or lying positions (such as muscle warm-up or deep breathing), followed by progression to standing exercises and walking activities. An important element of this approach is the use of musical accompaniment, which helps reduce anxiety and enhance motivation during rehabilitation (Clark et al., 2017) [20].

Specialized exercises include muscle relaxation exercises, dynamic breathing exercises, and physical exercises with measured dynamic effort. Relaxation of the skeletal musculature is facilitated by incorporating elements of autogenic training at the end of therapeutic gymnastics sessions. Rapid and abrupt movements, as well as exercises involving prolonged static exertion that increase adrenal gland activity, should be avoided. Preference is given to low-mobility ball games, walking at a normal pace in a calm tempo, muscle relaxation exercises for the trunk, arms, and legs, and static breathing exercises. Therapeutic physical culture for metabolic syndrome stimulates the nervous system and endocrine glands, improves metabolism, promotes glucose utilization by tissues, and reduces insulin requirements [21]. Therapeutic physical culture in dyscirculatory syndrome aims at preventing the development of micro- and macroangiopathies. Special attention is paid to preventing diabetic angiopathies, which reduce exercise tolerance. Therefore, in cases of pronounced angiopathies, non-intensive therapeutic physical culture regimens are prescribed, and in severe cases, physical exercises are contraindicated [22].

O.V. Peshkova distinguishes three stages of the physical activity regimen at the outpatient stage: sparing, sparing-training, and training [8]. During the sparing regimen, prescribed activities include measured walking, simple exercises with full amplitude, exercises with light weights (1–1.5 kg), static and dynamic breathing exercises, lasting 30–40 minutes, with a heart rate (HR) of resting plus 50–60% of the reserve. In the sparing-training regimen, exercise intensity increases, exercises with heavier weights (2–2.5 kg) are added, and the length of measured walking extends to 5–6 km at a pace of 70–90 steps per minute, lasting 40–45 minutes. The training regimen involves further increased loads: 10–14 repetitions, walking distances of 8–12 km, a pace of 70–100 steps per minute, inclusion of sports games, and moderate running with rest intervals.

The study by O.R. Barladin et al. emphasizes the importance of a systematic, phased application of physical rehabilitation in the comprehensive treatment of T2DM to maintain physical condition, prevent complications, and improve quality of life. The authors demonstrate the effectiveness of physical rehabilitation methods in normalizing glucose levels and overall bodily functions [21]. Results of using physical rehabilitation modalities at the outpatient rehabilitation stage for T2DM patients are presented, aiming to maintain and improve physical condition and work capacity throughout the patients' lives, as well as to prevent complications of various etiologies and comorbidities in this patient group. It was established that physical rehabilitation methods contribute to stable compensation of T2DM. Their effectiveness in addressing glucose level normalization, enhancing the function of all organs and systems, and improving patients' quality of life has been proven.

Physical exercise is an integral part of the proper comprehensive management of diabetes. Sport positively affects insulin sensitivity and improves mood. Regular physical activity contributes to increased life expectancy in patients with diabetes. Physical exercises help maintain a healthy body weight, positively influence the normalization of lipid profiles, glycemic levels, and tissue insulin sensitivity, as well as improve cardiovascular system function. Exercise is also an excellent way to enhance mood, which is often impaired during diabetes [22, 23].

Regular moderate-intensity physical activity has a beneficial effect on everyone, both healthy individuals and those with diabetes. While sport should not be perceived as a panacea, adequate physical exercise is a crucial factor in the therapy and prevention of many diseases, including T2DM. Scientific evidence confirms that engaging in physical activity at least once a week significantly reduces the risk of developing T2DM. Moreover, increasing energy expenditure by 500 kcal per session (e.g., a 40-minute run or a 1.5-hour walk) can decrease the likelihood of developing non-insulin-dependent diabetes by 6% [24]. In addition, regular exercise helps maintain or reduce body weight, which plays a vital role in preventing the development of T2DM.

Thus, engaging in ≥ 500 kcal worth of physical activity (e.g., a 40-minute run or a 1.5-hour walk) reduces the risk of developing T2DM by approximately 6%. Studies also confirm the importance of regular moderate-intensity and resistance physical activity for diabetes prevention. Such activity has a positive effect on lowering blood glucose levels and allows for a reduction in the dosage of glucose-lowering medications or the number of insulin units administered as part of diabetes therapy [25, 26].

In the study [4], the authors developed and tested a comprehensive physical rehabilitation program for patients with T2DM, which included physical therapy interventions aimed at improving both physical health and the psychological attitude toward recovery. The program was implemented in stages, following a planned and sequential structure. The study involved 11 women aged 25 to 38 years diagnosed with moderate T2DM in a subcompensated stage; the average duration of the disease was 4.6 ± 2.3 years.

All participants underwent comprehensive clinical and laboratory assessments at the beginning and end of the rehabilitation program,

including consultations with an endocrinologist and a neurologist. The physical therapy program was delivered alongside social and psychological rehabilitation. The planning of the physical therapy was based on a personalized approach, taking into account several factors: the clinical course and compensation status of the disease, the presence of diabetic complications, previous physical activity experience and response, comorbidities, the psycho-emotional condition of the patient, rehabilitation stage, and age.

Evaluation of the functional state of the cardiovascular and respiratory systems (heart rate, blood pressure, resting respiratory rate, Stange and Genchi tests) demonstrated significant improvement in these parameters. The body mass index, which indicated excess weight in all participants at the beginning of the study, returned to normal values by the end of the program. The findings confirm the effectiveness of the physical therapy program in improving cardiovascular function, increasing physical capacity, normalizing body weight, stabilizing psycho-emotional status, and enhancing the overall well-being of the patients.

Discussion

A review of recent scientific literature confirms that physical rehabilitation methods play a crucial role in the comprehensive treatment of patients with T2DM. Among the most effective components are therapeutic exercise (physical therapy), massage, hardening procedures, diet therapy, and phytotherapy. Several authors emphasize the importance of an individualized approach to the development of physical therapy programs, taking into account the clinical form of the disease, the degree of glycemic compensation, the patient's functional capacity, and contraindications [27, 28].

Type 2 diabetes mellitus carries significant social implications due to early disability and mortality associated with its complications. Therefore, the primary goals of therapy are achieving metabolic control, preventing chronic complications, and ensuring a high quality of life. According to researchers, the success of rehabilitation largely depends on the integration of physical therapy, physiotherapeutic procedures, and massage. Additionally, the inclusion of yoga elements and breathing exercises has been shown to support improved glycemic control [29, 30].

Kinesiotherapy methods, adapted to age-related characteristics and clinical course, have demonstrated their effectiveness in improving patients' functional activity, particularly among middle-aged and older women. For example, a randomized controlled trial showed that an adapted physical activity program over 25 weeks significantly improved static balance (one-leg stance test and Timed Up and Go test), mobility, and quality of life components (physical functioning, vitality, overall health status) in women over 60 years old in an outpatient setting (n = 76) [31]. Another RCT study reported significant increases in knee extensor strength and quadriceps thickness in the training group, as well as improvements in metabolic profile (decreased triglycerides) without deterioration in quality of life among 44 elderly diabetic patients (mean age ~70 years). These participants were randomized to a resistance training group (3 sessions per week for 12 weeks) or a control group (stretching) [32].

The study also demonstrated reductions in glucose levels, HbA1c, HOMA-IR, and body fat percentage, along with increases in muscle strength and oxygen uptake, indicating improved physical condition and metabolism in 122 elderly diabetic patients with sarcopenia during a 12-week inpatient physical rehabilitation program that incorporated both resistance and aerobic exercises [33].

These findings indicate that regular kinesiotherapy (resistance training and combined exercise programs) in elderly patients with T2DM contributes to increased muscle strength and mass, particularly in the lower limbs; improved metabolic parameters (glycemic control, adipose tissue); and overall enhancement of functional status.

Thus, the improvement of physical rehabilitation methods for patients with T2DM remains a relevant direction. The development of individualized programs should be based on clinical and physiological examinations, analysis of functional status, and evidence of effectiveness from scientific and methodological literature. Most authors recommend including in the rehabilitation complex measures aimed at preventing and correcting complications: breathing exercises, coordination and vestibular stability training, gymnastics for the lower limbs, back and abdominal muscles, as well as graded walking and reflex massage of the cervical-collar zone [34, 35].

Conclusions

The results of the conducted analysis indicate that the inclusion of physical rehabilitation methods and techniques in the comprehensive therapy of patients with type 2 diabetes contributes to increased effectiveness of pharmacological treatment, improvement of the clinical course of the disease, and reduction of the risk of complications. The application of individualized programs of therapeutic physical culture, massage, hardening procedures, dietotherapy, and phytotherapy has significant preventive and therapeutic potential, confirming the advisability of integrating physical rehabilitation into the standards of care for patients with type 2 diabetes.

Prospects for Further Research

A promising direction in this field is the development of therapeutic exercise methodologies incorporating breathing and general developmental exercises tailored for patients with type 2 diabetes, depending on their glycemic levels and physical capacity.

ORCID authors

Voitenko D.O., ORCID ID: 0009-0002-4617-341X

Golovchenko I.V., ORCID ID: 0000-0003-2153-2367

Tarasova O.O. ORCID ID: 0000-0002-6828-1326

Morozenko D.V. ORCID ID: 0000-0001-6505-5326

Danylchenko S.I., ORCID ID: 0000-0001-5312-0231

Statement of Ethics

The authors have no ethical conflicts to disclosure.

References

1. World Health Organization. World Health Organization. *Diabetes*. WHO Fact Sheet. Updated 2024 Nov 14. Available from: https://www.who.int/health-topics/diabetes#tab=tab_1
2. Magliano DJ, J Boyko E, Eds.; International Diabetes Federation. Global and regional diabetes prevalence estimates for 2019–2045: Results from the IDF Diabetes Atlas, 11th edition. Brussels: IDF; 2025. 130 p.
3. Ukrinform. 1.2 million people with diabetes in Ukraine, the real number may be higher – Ministry of Health of Ukraine. 2024 Nov 14. Available from: https://www.ukrinform.ua/rubric-society/3927019-v-ukraini-12-miljona-ludej-z-cukrovim-diabetom-realna-kilkist-moze-buti-bilsou-lasko.html (Ukrainian).
4. Andriychuk OY, Ulyanytska NY, Yakobson OO, Hreida NB, Maistruk MI. An impact of physical therapy on the life quality of the patients with comorbid states. Art of Medicine. 2021;2:7-14. DOI: 10.21802/artm.2021.2.18.7(Ukrainian).
5. Colberg SR, Albright AL, Blissmer BJ, Braun B, Chasan-Taber L, Fernhall B, et al.; American College of Sports Medicine; American Diabetes Association. Exercise and type 2 diabetes: American College of Sports Medicine and the American Diabetes Association: joint position statement. Exercise and type 2 diabetes. Med Sci Sports Exerc. 2010 Dec;42(12):2282-303. doi: 10.1249/MSS.0b013e3181eeb61c.
6. Kirwan JP, Sacks J, Nieuwoudt S.The essential role of exercise in the management of type 2 diabetes. Cleve Clin J Med. 2017 Jul;84(7 Suppl 1):S15-S21. doi: 10.3949/ccjm.84.s1.03.
7. Kalmykov SA, Kalmykova YuS. Modern views on the use of therapeutic physical culture techniques in physical therapy of patients with type 2 diabetes. Physical rehabilitation and recreational and health technologies. 2017;1:10-15. (Ukrainian)
8. Peshkova OV. Physical rehabilitation for diseases of internal organs. Kharkiv: SPDFO Brovin O.V.; 2011. 139 p. P. 228-236. (Ukrainian).
9. Kalmykov SA. Dynamics of carbohydrate metabolism in patients with type 2 diabetes mellitus against the background of the use of physical rehabilitation methods. Slobozhansky Scientific and Practical Bulletin. 2012;(5-1 (32)):102- 105. (Ukrainian)
10. Kalmykov SA. Study of the variability of hemodynamic indicators, the state of the autonomic nervous system and the level of glycemia in patients with type II diabetes mellitus against the background of the use of physical rehabilitation tools. Medical Perspectives. 2010;15(4):46-51. (Ukrainian)
11. Doupis J, Karras K, Avramidis K. The Role of Individualized Exercise Prescription in Type 2 Diabetes Mellitus Management. touchREV Endocrinol. 2021 Apr;17(1):2-4. doi: 10.17925/EE.2021.17.1.2.
12. Ribeiro AKPL, Carvalho JPR, Bento-Torres NVO. Physical exercise as treatment for adults with type 2 diabetes: a rapid review. Front Endocrinol (Lausanne). 2023 Sep 28;14:1233906. doi: 10.3389/fendo.2023.1233906.
13. Way KL, Hackett DA, Baker MK, Johnson NA. The Effect of Regular Exercise on Insulin Sensitivity in Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis. Diabetes Metab J. 2016 Aug;40(4):253-71. doi: 10.4093/dmj.2016.40.4.253.
14. Kirwan JP, Solomon TP, Wojta DM, Staten MA, Holloszy JO. Effects of 7 days of exercise training on insulin sensitivity and responsiveness in type 2 diabetes mellitus. Am J Physiol Endocrinol Metab. 2009 Jul;297(1):E151-6. doi: 10.1152/ajpendo.00210.2009.
15. Reusch JE, Bridenstine M, Regensteiner JG. Type 2 diabetes mellitus and exercise impairment. Rev Endocr Metab Disord. 2013 Mar;14(1):77-86. doi: 10.1007/s11154-012-9234-4.
16. Mousavi Zadeh SA, Caminiti G, Aracri M, Pieri M, Mitterhofer AP, De Lorenzo A, et al. Comparative Analysis of Cardiovascular Outcomes in Type 2 Diabetes Patients Engaging in Aerobic, Resistance, and Combined Training: A Systematic Review. Diabetology. 2025;6(5):38. doi: 10.3390/diabetology6050038
17. Foot and Ankle Associates of North Texas. Type 2 Diabetics Need To Exercise! New Guidelines. Available from: https://www.faant.com/library/new-exercise-guidelines-in-type-2-diabetics.cfm?utm_source=chatgpt.com
18. Dotdash Meredith: EatingWell. Walking After Meals for Just 2 Minutes Is Enough to Lower Blood Sugar - Here's Why, According to Science. Available from: https://www.eatingwell.com/article/7998411/walking-after-meals-lower-blood-sugar-science/?utm_source=chatgpt.com
19. Bellini A, Scotto di Palumbo A, Nicolò A, Bazzucchi I, Sacchetti M. Exercise Prescription for Postprandial Glycemic Management. Nutrients. 2024 Apr 14;16(8):1170. doi: 10.3390/nu16081170.
20. Clark IN, Baker FA, Peiris CL, Shoebridge G, Taylor NF. Participant-selected music and physical activity in older adults following cardiac rehabilitation: a randomized controlled trial. Clin Rehabil. 2017 Mar;31(3):329-339. doi: 10.1177/0269215516640864.
21. Barladyn OR, Vakulenko LO, Hrabra SZ, Veremchuk OD, Gavran TS. Effectiveness of physical rehabilitation in the complex treatment of patients with type 2 diabetes. Scientific journal of the National Polytechnic University named after MP Dragomanov. 2021;9:21-24. (Ukrainian).
22. Colberg SR, Grieco CR. Exercise in the treatment and prevention of diabetes. Curr Sports Med Rep. 2009 Jul-Aug;8(4):169-75. doi: 10.1249/JSR.0b013e3181ae0654.
23. Jeon CY, Lokken RP, Hu FB, van Dam RM. Physical activity of moderate intensity and risk of type 2 diabetes: a systematic review. Diabetes Care. 2007 Mar;30(3):744-52. doi: 10.2337/dc06-1842.
24. Aune D, Schlesinger S, Leitzmann MF, Tonstad S, Norat T, Riboli E, et al. Physical activity and the risk of heart failure: a systematic review and dose-response meta-analysis of prospective studies. Eur J Epidemiol. 2021 Apr;36(4):367-381. doi: 10.1007/s10654-020-00693-6.
25. InterAct Consortium; Ekelund U, Palla L, Brage S, Franks PW, Peters T, Balkau B, et al. Physical activity reduces the risk of incident type 2 diabetes in general and in abdominally lean and obese men and women: the EPIC-InterAct Study. Diabetologia. 2012 Jul;55(7):1944-52. doi: 10.1007/s00125-012-2532-2.
26. Jiang T, Ye Z, Lu Q, Cheng P, Gao Q. Effect of Aerobic Exercise on Blood Glucose Among Those with Prediabetes: A Systematic Review and Meta-Analysis. Life. 2025; 15(1):32. doi: 10.3390/life15010032
27. Geidl W, Pfeifer K. Physical activity and exercise for rehabilitation of type 2 diabetes. Rehabilitation (Stuttg). 2011 Aug;50(4):255-65. doi: 10.1055/s-0031-1280805. (German).
28. Shawahna R, Batta A, Asa'ad M, Jomaah M, Abdelhaq I. Exercise as a complementary medicine intervention in type 2 diabetes mellitus: A systematic review with narrative and qualitative synthesis of evidence. Diabetes Metab Syndr. 2021 Jan-Feb;15(1):273-286. doi: 10.1016/j.dsx.2021.01.008.
29. Zhao H, Teng J, Song G, Fu X, Pan X, Shen S, et al. The optimal exercise parameters of Tai Chi on the effect of glucose and lipid metabolism in patients with type 2 diabetes mellitus: A meta-analysis. Complement Ther Med. 2023 Dec;79:102995. doi: 10.1016/j.ctim.2023.102995.
30. Wu S, Wang L, He Y, Shi F, Zhuang H, Mei L, et al. Effects of different mind-body exercises on glucose and lipid metabolism in patients with type 2 diabetes: A network meta-analysis. Complement Ther Clin Pract. 2023 Nov;53:101802. doi: 10.1016/j.ctcp.2023.101802.
31. Kovács E, Prókai L, Mészáros L, Gondos T. Adapted physical activity is beneficial on balance, functional mobility, quality of life and fall risk in community-dwelling older women: a randomized single-blinded controlled trial. Eur J Phys Rehabil Med. 2013 Jun;49(3):301-10.
32. Botton CE, Umpierre D, Rech A, Pfeifer LO, Machado CLF, Teodoro JL, et al. Effects of resistance training on neuromuscular parameters in elderly with type 2 diabetes mellitus: A randomized clinical trial. Exp Gerontol. 2018 Nov;113:141-149. doi: 10.1016/j.exger.2018.10.001.
33. Abdelbasset WK. Resistance Exercise Versus Aerobic Exercise Combined with Metformin Therapy in the Treatment of type 2 Diabetes: A 12-Week Comparative Clinical Study. Endocr Metab Immune Disord Drug Targets. 2021;21(8):1531-1536. doi: 10.2174/1871530320999200918143227.
34. Yang D, Yang Y, Li Y, Han R. Physical Exercise as Therapy for Type 2 Diabetes Mellitus: From Mechanism to Orientation. Ann Nutr Metab. 2019;74(4):313-321. doi: 10.1159/000500110.
35. Geidl W, Pfeifer K. Physical activity and exercise for rehabilitation of type 2 diabetes. Rehabilitation (Stuttg). 2011 Aug;50(4):255-65. doi: 10.1055/s-0031-1280805. (German).

Реферат

ФІЗИЧНА АКТИВНІСТЬ І РЕАБІЛІТАЦІЙНІ СТРАТЕГІЇ В КОМПЛЕКСНОМУ ЛІКУВАННІ ЦУКРОВОГО ДІАБЕТУ 2-ГО ТИПУ
Войтенко Д.О., Головченко І.В., Тарасова О.О., Морозенко Д.В., Данильченко С.І.
Ключові слова: глікемічний контроль, профілактика ускладнень, кінезотерапія, серцево-судинні ризики, індивідуалізація навантажень

Цукровий діабет 2-го типу є однією з найпоширеніших неінфекційних хвороб сучасності, що супроводжується високими ризиками ускладнень, інвалідизації та зниженням якості життя. У зв'язку з цим зростає потреба в ефективних немедикаментозних підходах до лікування, зокрема у фізичній реабілітації та адаптованій фізичній активності.

Мета. Узагальнити наукові дані щодо ролі фізичної активності та реабілітаційних технологій у системі комплексного лікування пацієнтів із цукровим діабетом 2-го типу, проаналізувати ефективність існуючих підходів з урахуванням клінічних, функціональних та вікових особливостей пацієнтів.

Матеріали та методи. Проведено аналітичний огляд 35 наукових джерел, опублікованих у міжнародних базах даних (PubMed, Scopus, Web of Science) за останні роки. Відібрані дослідження відповідали тематиці фізичної терапії при діабеті 2-го типу, відзначалися високою методологічною якістю, містили дані про вплив фізичної активності на метаболічні, функціональні й психоемоційні показники.

Результати. У статті узагальнено сучасні підходи до використання лікувальної фізичної культури, кінезотерапії, масажу, гідропроцедур, дієтотерапії та фітотерапії в лікуванні ЦД 2-го типу. Окрема увага приділена значенню індивідуалізації фізичних навантажень із урахуванням рівня компенсації захворювання, наявності серцево-судинних порушень, ступеня фізичної підготовки та супутніх патологій. Встановлено, що фізичні вправи помірної інтенсивності (60–75 % МІМН) сприяють покращенню чутливості до інсуліну, зниженню маси тіла, нормалізації глікемії та профілактиці ускладнень. Підкреслено значення поступового нарощування фізичної активності, контролю рівня глюкози до і після тренування, а також важливість психоемоційної підтримки.

Висновки. Інтеграція засобів фізичної реабілітації в систему лікування ЦД 2-го типу дозволяє суттєво підвищити ефективність терапії, покращити якість життя пацієнтів та зменшити ризик розвитку ускладнень. Перспективним напрямом є створення диференційованих програм реабілітації, що враховують клініко-фізіологічні параметри та адаптовані до потреб конкретного пацієнта.