The effect of physical activity in older adults with type 2 diabetes

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ABSTRACT
Physical activity represents one of the key approaches in managing type 2 diabetes (T2D) in older adults. An active lifestyle significantly contributes to better health, especially when it is planned and supervised by healthcare professionals. Physiotherapists play a central role in this area by ensuring that physical activity is appropriate and individually tailored. The purpose of this paper is to present scientific evidence on the relationship between physical activity and its physiological effects on T2D in older adults. A descriptive method was used, based on a review of scientific literature. The inclusion criteria for article selection were meta-analyses and randomized controlled trials that examined the effects of physical activity on T2D. Special attention was given to studies investigating the effects of physiotherapist-led physical activity in older adults with T2D. The results confirm a significant corelation between physical activity, aging, and T2D, and highlight the positive adaptive effects of properly guided physical activity. Introducing guidelines for the physiotherapy management of T2D in older adults may contribute to the further development of preventive strategies and improve the effectiveness of the healthcare system at all levels, offering a sustainable solution for enhancing individuals' quality of life. **Keywords:** Older adults, diabetes, physiotherapy, physical activity

Učinek telesne dejavnosti pri starejših odraslih s sladkorno boleznijo tipa 2

POVZETEK
Telesna dejavnost predstavlja enega izmed ključnih pristopov pri obvladovanju sladkorne bolezni tipa 2 (SB2) pri starejših odraslih. Aktiven življenski slog pomembno prispeva k boljšemu zdravstvenemu stanju, še posebej kadar je načrtovan in nadzorovan s strani zdravstvenega osebja. Fizioterapevti igramo ključno vlogo na tem področju, saj skrbimo za ustrezno in individualno prilagojeno telesno aktivnost. Namen prispevka je predstaviti znanstvene dokaze o pozitivnem vplivu telesne dejavnosti na SB2 pri starejših odraslih. Uporabljena je bila opisna metoda, ki temelji na pregledu znanstvene literature. Vključitvena merila pri izboru člankov so bile študije tipa metaanalize in randomizirane ter kontrolirane klinične študije, v katerih so avtorji preučavali vpliv telesne dejavnosti na SB2. Poseben poudarek je bil na študijah, ki so obravnavale učinke fizioterapevtsko vodene telesne dejavnosti pri starejših osebah s SB2. Rezultati kažejo povezavo med telesno dejavnostjo, starostjo in SB2 ter poudarjajo pozitivne učinke prilagoditve ustrezne telesne aktivnosti posamezniku. Predstavitev smernic za obravnavo SB2 pri starejših odraslih v fizioterapiji lahko prispeva k nadaljnjemu razvoju preventivnih pristopov in izboljšanju delovanja zdravstvenega sistema na vseh ravneh kot trajnostna rešitev za boljšo kakovost življenja posameznika. **Ključne besede**: starejši odrasli, diabetes, fizioterapija, telesna dejavnost.

INTRODUCTION

In recent years, there has been significant growth and aging of the global population. According to the World Health Organization (19), the proportion of individuals over 60 years of age is projected to double by 2050, increasing from 900 million in 2015 to 2 billion. A recent study indicates that between 2015 and 2030, approximately 200 million individuals in the Asia-Pacific region will reach 65 years of age or older. Extended life expectancy correlates with a heightened risk of disability. Additionally, older adults are more susceptible to emotional distress, elevating the likelihood of depression and other mental health disorders (1).

As people age, various needs intensify, closely linked to their aging experience. Some individuals maintain physical and mental vitality for an extended period, engaging in activities such as travel, driving, sports participation, volunteering, or pursuing hobbies. Conversely, others may suffer from illness or frailty, necessitating assistance with basic daily tasks such as eating and personal hygiene. Aging involves a natural decline in physical and mental functions, increasing the risk of developing age-related diseases, including Alzheimer's disease, Parkinson's disease, atherosclerosis, depression, and Type 2 Diabetes (T2D). These conditions often demand additional care and comprehensive treatment. Apart from social, economic, and societal security, an active lifestyle is crucial for older adults, as it underpins the maintenance of health and physical fitness (2).

Currently, diabetes affects approximately 382 million adults globally, with 85–95% of cases identified as T2D. A sedentary lifestyle is one of the primary risk factors for its development. Patients with T2D frequently display symptoms such as dyslipidemia, hypertension, and hyperinsulinemia, which are associated with metabolic syndrome (MetS) and elevate cardiovascular disease risks (15). Diabetes is a chronic endocrine disease marked by a high morbidity rate and poses an increasing public health challenge. It is characterized by insulin resistance, heightened hepatic glucose production, and impaired fat metabolism. The disease impacts small blood vessels, leading to numerous musculoskeletal and vascular complications. If left untreated, diabetes can result in peripheral neuropathy, which causes sensory and motor issues that affect gait and balance, thereby heightening fall risks. These complications, along with decreased muscle strength, significantly diminish patients' quality of life (5).

The risk of T2D is linked to several factors, many of which are modifiable, including overweight, obesity, sedentary behavior, smoking, and alcohol use. Even a reduction of more than 3% in body weight can yield substantial clinical benefits, such as decreases in triglycerides, blood glucose, and glycated hemoglobin levels (10).

The management of T2D typically begins with pharmacological interventions aimed at lowering blood sugar levels. However, there is a growing trend towards holistic approaches that extend beyond glucose control and effectively prevent disease complications (10).

Physical activity is recognized as one of the most effective strategies for enhancing overall physical fitness and mobility. Research indicates that exercise improves glycemic control, increases energy expenditure, and facilitates glucose transport into cells through insulin-dependent mechanisms (5). Therefore, regular physical activity is integral to the management of T2D and is incorporated into all contemporary therapeutic guidelines. A combination of aerobic exercise and strength training is recommended, as the enhancement of muscle mass has been shown to positively influence health status, including cardiorespiratory fitness, muscle strength, endurance, body composition, and metabolism (4). Furthermore, physical activity guidelines for older adults advocate for fall prevention. There is compelling evidence that a well-structured intervention program can mitigate fall risk in the elderly population (16).

METHODS

We used a descriptive method and conducted a systematic literature review. The review process is presented using the PRISMA methodology (Figure 1). The inclusion criteria for the literature search were as follows: scientific articles in English (clinical controlled trials, randomized controlled trials, case series studies), full-text free access, and a publication period between 2016 and 2025. The search was conducted in the PubMed and PEDro databases.

Exclusion criteria included publications involving children, pilot studies, articles where physical activity was not a central part of the intervention, studies without a comparison group, and physical activity measured non-objectively via survey questionnaires. The keywords used, connected by the Boolean operator (AND), were in English: older adults, diabetes, physical therapy, exercise. By specifying search terms and using various combinations of keywords, we retrieved a total of 169 results (168 from PubMed, 1 from PEDro). Upon reviewing the titles, we excluded articles that did not address the connection between physical activity and diabetes, continuing with 26 scientific papers (25 from PubMed, 1 from PEDro). In the final step, we assessed the abstracts for relevance according to the inclusion and exclusion criteria. We excluded those that did not describe the impact of physical activities guided by physiotherapists on immune, cardiovascular, or metabolic changes. Ultimately, we included 9 relevant articles in the review (8 from PubMed and 1 from PEDro).

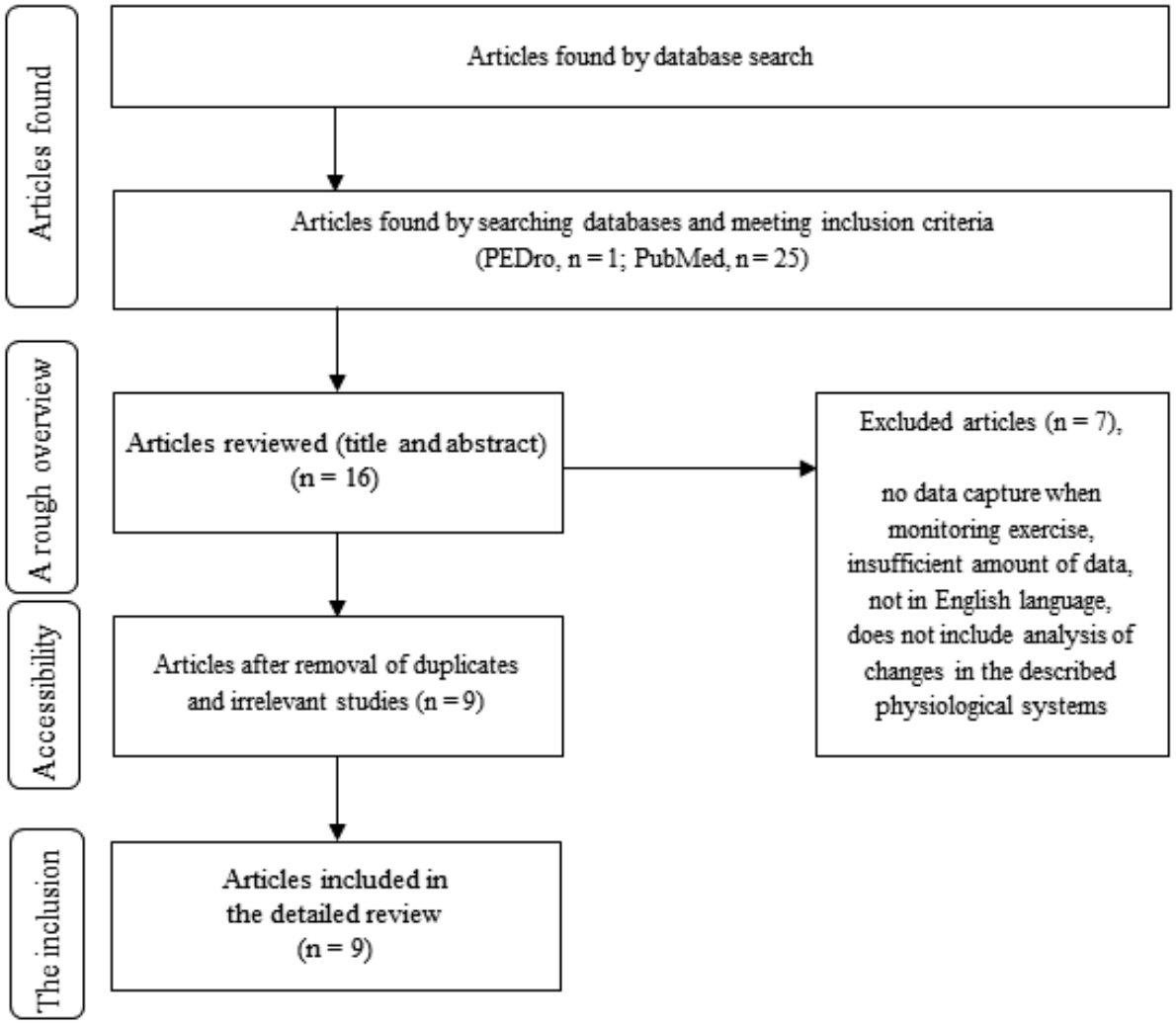

Figure 1: Flow chart of the review process according to PRISMA methodology.

RESULTS

Table 1: Characteristics of included studies.

Title Authors and year of publication	Sample properties	Study objective	Results
Exercise training modalities in patients with type 2 diabetes mellitus: a systematic review and network meta-analysis Pan, Bei et al., 2018 (15)	N=37 studies; N=2208 individuals with T2D (42-73 years)	Comparative differences between different exercise training methods for patients with T2D.	Combined exercise showed a significant improvement in HbA1c levels. Weight loss showed no significant differences between combined, supervised aerobic and supervised resistance exercise.
Aerobic, resistance or combined training: A systematic review and meta-analysis of exercise to reduce cardiovascular risk in adults with metabolic syndrome Wewege et al., 2018 (17)	N=16 studies; N=588 healthy individuals (< 67 years)	The review examined aerobic, resistance, and combined exercise for cardiovascular disease risk factors in MetS without diabetes.	Aerobic exercise according to current guidelines offers broad benefits for individuals with and without MetS.
Clinical outcomes and glycaemic responses to different aerobic exercise training intensities in type II diabetes: a systematic review and meta-analysis Grace et al., 2017 (6)	N=27 studies; N=38 intervention groups N=1372 individuals with T2D (>18 years)	To determine whether aerobic exercise training is associated with beneficial effects on clinical outcomes and glycemic profile in people with T2D.	Higher intensity exercise offers excellent fitness benefits, and a longer program duration will optimize HbA1C reduction.
High-intensity interval training versus continuous training on physiological and metabolic variables in prediabetes and type 2 diabetes: A meta-analysis De Nardi et al., 2018 (3)	N=7 studies; N=184 individuals (64 with prediabetes and 120 with T2D) (age 41-76.9 years)	To compare the effects of HIIT versus MICT on functional performance and cardiometabolic markers in individuals with prediabetes and T2D.	HIIT induces cardiometabolic adaptations similar to those of MICT in prediabetes and T2D, and provides greater benefits for functional performance in patients with T2D.

Title Authors and year of publication	Sample properties	Study objective	Results
The Effects of Structured Exercise or Lifestyle Behavior Interventions on Long-Term Physical Activity Level and Health Outcomes in Individuals With Type 2 Diabetes: A Systematic Review, Meta-Analysis, and Meta-Regression Mosalman Haghighi et al., 2018 (13)	N=23 studies; N=9640 individuals with T2D (43.6% men; age 60.0±4 years)	Systematically evaluate the effects of structured exercise and behavioral interventions (physical activity + diet) on long-term physical activity in T2D.	Structured exercise as well as behavioral interventions increased physical activity in T2D, although the effects were greater with supervised exercise.
Effects of Whole-Body Vibration in Older Adult Patients With Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis Gomes-Neto et al., 2019 (5)	N=7 studies; N=279 individuals with T2D	To determine the effects of whole-body vibration training on metabolic abnormalities, mobility, balance, and aerobic capacity in older adult patients with T2D.	Whole-body vibration could be a useful strategy in managing symptoms and disability associated with T2D.
Comparison between different types of exercise training in patients with type 2 diabetes mellitus: A systematic review and network metanalysis of randomized controlled trials Mannucci et al., 2021 (12)	N=26 studies; N=2065 individuals with T2D (50-69 years)	Evaluation of the effects of physical exercise on glucose control and cardiovascular risk factors in T2D.	Exercise provides small but significant benefits on glycemic control and cardiovascular risk factors. Combined aerobic/resistance training appears to be superior to aerobic training alone, but the differences are small and the strength of the supporting evidence is limited.

Title Authors and year of publication	Sample properties	Study objective	Results
Cardiopulmonary and Metabolic Benefits of the High-Intensity Interval Training Versus Moderate, Low-Intensity or Control for Type 2 Diabetes: Systematic Review and Meta-Analysis Lora-Pozo et al., 2019 (10)	N=10 studies; N= 532 individuals with T2D (289 men and 243 women) (41.6-72.5 years)	To evaluate the effectiveness of high-intensity interval training compared to no intervention and other types of exercise interventions for people with T2D.	The results suggest that high-intensity HIIT may be a useful strategy for improving anthropometric, cardiopulmonary, and metabolic parameters in people with T2D.
Fall and Balance Outcomes After an Intervention to Promote Leg Strength, Balance, and Walking in People With Diabetic Peripheral Neuropathy: "Feet First" Randomized Controlled Kruse, R. L. et al., 2010 (8)	N=79 individuals with T2D and peripheral neuropathy Duration: 8 weeks Group 1 N=38 (20 women) (64.8±9.4 years) Leg strengthening and balance Group 2 N=41 (20 women) (66.3±10.6 years) Self-care advice	Effect of weight-bearing exercise on foot ulcers in people with T2D + peripheral neuropathy, effects of lower limb exercise and walking on balance, lower limb strength.	It appears that sedentary people with T2D + peripheral neuropathy can increase activity without increasing their fall rate.

HIIT – high-intensity interval training; MetS – metabolic syndrome; MICT – moderate-intensity continuous training; T2D – type 2 diabetes

DISCUSSION

Research in the field of physical activity and T2D unanimously emphasizes the positive impact of various forms of exercise on metabolic parameters, physical performance and quality of life, especially in the elderly population. Awareness of the importance of physical activity in the management of T2D is becoming increasingly crucial, as it is a disease that is in most cases the result of lifestyle – mainly inactivity, excess weight and unhealthy diet.

T2D is the most common form of diabetes and is particularly prevalent among the elderly population, representing between 85–95% of all cases. A sedentary lifestyle is one of the main risk factors, and physical activity is considered an effective strategy in the prevention and management of the disease (15).

Based on a literature review, we analyzed the effects of different exercise approaches (from HIIT and MICT to combined exercises) on metabolic parameters in elderly people with T2D. Findings of the recent study (5) showed that whole-body vibration training positively affects metabolic abnormalities, balance, mobility and aerobic capacity in this population. It has been reported (8) that lower limb training does not significantly improve balance and strength in individuals with T2D and peripheral neuropathy, but represents an important support in maintaining functionality.

A meta-analysis (17), which included 588 healthy older adults over 67 years, reported improvements in metabolic and cardiovascular parameters with regular aerobic physical activity (at least 3x per week, for at least 4 weeks). Even greater benefits were observed with programs longer than 12 weeks. The benefits of exercise (including HIIT) have been confirmed (6) in individuals with T2D of all ages, with the greatest benefits, reductions in HbA1c and improvements in physical fitness, being achieved with higher intensity and longer duration exercise. Further studies (3, 10) have shown that HIIT leads to similar or even greater cardiometabolic benefits than MICT, and may contribute to improved functional capacity. Combined exercise leads to greater improvements in HbA1c levels than aerobic or resistance exercise alone, although without significant differences in weight loss (15). Positive effect of structured exercise has been reported on metabolic markers, especially when the exercise was supervised (13).

Despite the positive effects of exercise, some studies show that in advanced diabetes, when peripheral neuropathies occur and the risk of falls increases, the effects of exercise on balance and muscle strength are not always sufficient. Nevertheless, physical activity remains an important tool for maintaining functionality and independence in older people with T2D.

CONCLUSION

Physical activity represents one of the most important non-pharmacological strategies for the management of type 2 diabetes in older individuals. Various forms of exercise – from aerobic to combined and high-intensity interval training – have been shown to contribute to the improvement of metabolic, cardiovascular and physical indicators.

In addition to the general benefits, each form of exercise has its own specific impact, therefore, individualization of the exercise program according to the physical fitness, health status and goals of the individual is crucial. Physiotherapists and other health professionals play a key role in guiding patients to safely and effectively integrate physical activity into their daily lives.

Based on the existing evidence, we believe that appropriately planned and supervised physical activity is an indispensable part of a comprehensive approach to the management of T2D in older individuals. Its role goes beyond simply lowering blood glucose – it also has a significant impact on quality of life, physical independence and reducing complications of the disease.

LITERATURE

1. Choo, Y. T., Jiang, Y., Hong, J., & Wang, W. (2020). Effectiveness of Tai Chi on quality of life, depressive symptoms and physical function among community-dwelling older adults with chronic disease: A systematic review and meta-analysis. International journal of nursing studies, 111, 103737.
2. Crocker, T. F., Brown, L., Clegg, A., Farley, K., Franklin, M., Simpkins, S., & Young, J. (2019). Quality of life is substantially worse for community-dwelling older people living with frailty: systematic review and meta-analysis. Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation, 28(8), 2041–2056.
3. De Nardi, A. T., Tolves, T., Lenzi, T. L., Signori, L. U., & Silva, A. M. V. D. (2018). High-intensity interval training versus continuous training on physiological and metabolic variables in prediabetes and type 2 diabetes: A meta-analysis. Diabetes research and clinical practice, 137, 149–159.
4. García-Hermoso, A., Ramírez-Vélez, R., Ramírez-Campillo, R., Peterson, M. D., & Martínez-Vizcaíno, V. (2018). Concurrent aerobic plus resistance exercise versus aerobic exercise alone to improve health outcomes in paediatric obesity: a systematic review and meta-analysis. British journal of sports medicine, 52(3), 161–166.
5. Gomes-Neto, M., de Sá-Caputo, D. D. C., Paineiras-Domingos, L. L., Brandão, A. A., Neves, M. F., Marin, P. J., Sañudo, B., & Bernardo-Filho, M. (2019). Effects of Whole-Body Vibration in Older Adult Patients With Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis. Canadian journal of diabetes, 43(7), 524–529.

6. Grace, A., Chan, E., Giallauria, F., Graham, P. L., & Smart, N. A. (2017). Clinical outcomes and glycaemic responses to different aerobic exercise training intensities in type II diabetes: a systematic review and meta-analysis. Cardiovascular diabetology, 16(1), 37.
7. Hespanhol Junior, L. C., Pillay, J. D., van Mechelen, W., & Verhagen, E. (2015). Meta-Analyses of the Effects of Habitual Running on Indices of Health in Physically Inactive Adults. Sports medicine (Auckland, N.Z.), 45(10), 1455–1468.
8. Kruse, R. L., Lemaster, J. W., & Madsen, R. W. (2010). Fall and balance outcomes after an intervention to promote leg strength, balance, and walking in people with diabetic peripheral neuropathy: "feet first" randomized controlled trial. Physical therapy, 90(11), 1568–1579.
9. Liu, J. X., Zhu, L., Li, P. J., Li, N., & Xu, Y. B. (2019). Effectiveness of high-intensity interval training on glycemic control and cardiorespiratory fitness in patients with type 2 diabetes: a systematic review and meta-analysis. Aging clinical and experimental research, 31(5), 575–593.
10. Lora-Pozo, I., Lucena-Anton, D., Salazar, A., Galán-Mercant, A., & Moral-Munoz, J. A. (2019). Anthropometric, Cardiopulmonary and Metabolic Benefits of the High-Intensity Interval Training Versus Moderate, Low-Intensity or Control for Type 2 Diabetes: Systematic Review and Meta-Analysis. International journal of environmental research and public health, 16(22), 4524.
11. Mabire, L., Mani, R., Liu, L., Mulligan, H., & Baxter, D. (2017). The Influence of Age, Sex and Body Mass Index on the Effectiveness of Brisk Walking for Obesity Management in Adults: A Systematic Review and Meta-Analysis. Journal of physical activity & health, 14(5), 389–407.
12. Mannucci, E., Bonifazi, A., & Monami, M. (2021). Comparison between different types of exercise training in patients with type 2 diabetes mellitus: A systematic review and network metanalysis of randomized controlled trials. Nutrition, metabolism, and cardiovascular diseases : NMCD, 31(7), 1985–1992.
13. Mosalman Haghighi, M., Mavros, Y., & Fiatarone Singh, M. A. (2018). The Effects of Structured Exercise or Lifestyle Behavior Interventions on Long-Term Physical Activity Level and Health Outcomes in Individuals With Type 2 Diabetes: A Systematic Review, Meta-Analysis, and Meta-Regression. Journal of physical activity & health, 15(9), 697–707.
14. Ostman, C., Smart, N. A., Morcos, D., Duller, A., Ridley, W., & Jewiss, D. (2017). The effect of exercise training on clinical outcomes in patients with the metabolic syndrome: a systematic review and meta-analysis. Cardiovascular diabetology, 16(1), 110.
15. Pan, B., Ge, L., Xun, Y. Q., Chen, Y. J., Gao, C. Y., Han, X., Zuo, L. Q., Shan, H. Q., Yang, K. H., Ding, G. W., & Tian, J. H. (2018). Exercise training modalities in patients with type 2 diabetes mellitus: a systematic review and network meta-analysis. The international journal of behavioral nutrition and physical activity, 15(1), 72.
16. Qiu, S., Cai, X., Yin, H., Sun, Z., Zügel, M., Steinacker, J. M., & Schumann, U. (2018). Exercise training and endothelial function in patients with type 2 diabetes: a meta-analysis. Cardiovascular diabetology, 17(1), 64.
17. Wewege, M. A., Thom, J. M., Rye, K. A., & Parmenter, B. J. (2018). Aerobic, resistance or combined training: A systematic review and meta-analysis of exercise to reduce cardiovascular risk in adults with metabolic syndrome. Atherosclerosis, 274, 162–171.
18. Wewege, M., van den Berg, R., Ward, R. E., & Keech, A. (2017). The effects of high-intensity interval training vs. moderate-intensity continuous training on body composition in overweight and obese adults: a systematic review and meta-analysis. Obesity reviews: an official journal of the International Association for the Study of Obesity, 18(6), 635–646.
19. World Health Organization. (2025). Ageing and health.