

Possible Advantages of Different Training Protocols in Patients with Diabetic Nephropathy: Mini Review

Nourhan Mohamed Ali Hussein^{1*}, Ahmed M Ahmed²,
Osama Mohamad Ahmad³, Heba Ali Abd El-Ghaffar²

¹ Department of Physical Therapy for Cardiovascular/Respiratory Disorders and Geriatrics, Faculty of Physical Therapy, Kafr El-Sheikh University, Egypt

² Department of Physical Therapy for Cardiovascular/Respiratory Disorders and Geriatrics, Faculty of Physical Therapy, Cairo University, Egypt,

³ Department of Internal Medicine, Faculty of Medicine, Al Azhar University, Egypt

Email: nourhanhussein2352013@gmail.com, Mobile: 01068325995

Abstract

Diabetes, particularly type 2 diabetes (T2D), poses a significant public health challenge, with projections indicating that over 783 million adults will be affected by 2045. A notable complication of T2D is chronic kidney disease (CKD), with individuals having a 50% risk of developing it, particularly characterized by albuminuria and reduced glomerular filtration rate (eGFR). Early screening for microalbuminuria is essential, as it is present in about 7% of newly diagnosed T2D patients. The rise of T2D has been particularly pronounced in regions undergoing epidemiological transitions, such as Asia and the Middle East, attributed to lifestyle changes and decreased nutritional quality. Diabetic nephropathy (DN) is a severe microvascular complication leading to end-stage renal disease (ESRD), with uncontrolled blood pressure and glucose levels being primary contributors. Accordingly, this mini-review aims to highlight the increasing prevalence of T2D and its significant association with CKD, emphasizing the importance of early screening and non-pharmacological interventions such as lifestyle modifications and exercise in managing diabetes and preventing renal and cardiovascular complications.

Keywords: Diabetes; Diabetic Nephropathy; Exercise; Lifestyle modifications

Receive Date: 15/10/2024

Accept Date: 10 / 11 / 2024

Publish Date: 1/3/2025

Background

Diabetes is a major public health concern that has an impact on both the cost of healthcare and human life. The International Diabetes Federation projects that by 2045, there will be more than 783.2 million adults with diabetes, up from an estimated 536.6 million in 2021 [1]. Individuals who have type 2 diabetes have a 50% chance of developing CKD. The Kidney Disease Improving Global Outcomes Work Group (KDIGO) recommendations specify chronic kidney disease (CKD) as the presence of albuminuria and/or a decline in less than 60 mL/min/1.73 m² is the estimated glomerular filtration rate (eGFR). Patients in this category include those with low eGFR with or without albuminuria (stages III, IV, and V) and those with elevated albuminuria but normal eGFR (stages I and II) [2]. Since microalbuminuria is present at diagnosis in about 7% of people with type 2 diabetes mellitus, early screening is crucial. Additionally, 30% of those with normal albuminuria and diabetes have a decreased glomerular

filtration rate (GFR). Recently, evaluation of serum creatinine levels has been advised in addition to albuminuria and GFR [3].

Over the past 40 years, there has been a significant global increase in T2D, a public health concern of enormous proportions. Some of the fastest rises in this disease have been seen in nations going through significant epidemiologic transformations, especially in Asia, the Middle East, and North Africa. Changes in living conditions and habits, which have resulted in drops in nutritional quality and rises in sedentary behaviors, have been primarily blamed for this increase [4]. Due to its significant co-morbidity (being blind, the requirement for amputations, and dialysis, among others), expense, and mortality (the annual mortality rate of diabetic patients with kidney failure on dialysis is approximately 25%), renal disease is regarded as the most unfavorable complication of diabetes. Uncontrolled blood pressure, blood glucose, and albuminuria are the main causes of kidney damage and the last stages of renal failure in individuals with type 2 diabetes [5]. Diabetic nephropathy (DN) is a feared chronic microvascular consequence of diabetes mellitus and the main cause of end-stage renal disease (ESRD). Hyperfiltration and albuminuria characterize the early phases of the typical presentation of diabetic kidney disease (DN), which is followed by a progressive decline in renal function. Diabetic kidney disease (DKD) can present in a variety of ways in people with T2DM, where the simultaneous presence of various glomerular/tubular diseases and severe peripheral vascular disease can become relevant determinants [6].

The current approach to treating diabetic neuropathy (DN) is multifactorial and focuses mostly on lifestyle modifications together with concurrent glycaemic, blood pressure, and cholesterol control. The results of significant, historic clinical trials have a significant impact on this. In T1DM, The DCCT, or Diabetes Control and Complications Trial, showed the noteworthy benefits of rigorous glycaemic control in averting GFR reduction and the onset and advancement of proteinuria [6]. High-intensity interval training, or HIIT, has become more and more popular since it results in higher endothelial function, functional capacity, body composition, and quality of life than traditional exercise while taking less time [7]. High-intensity interval training (HIT) with low volume is becoming a popular time-efficient workout method for enhancing fitness and health [8]. It has been demonstrated that consistent endurance-style exercise training lowers blood HbA1c, improves insulin sensitivity, lowers adipose tissue mass, and improves the risk of cardiovascular disease profile Among those who have type 2 diabetes. Furthermore, the only interventional technique that has been repeatedly demonstrated to increase skeletal muscle and whole-body oxidative capacity is exercise training [9].

Main text

The primary goals of non-pharmacological treatment for diabetes mellitus (DM) are dietary modifications, physical activity (PA), and quitting smoking [10]. Improved albuminuria has been linked to a sharp decline in renal function, and microalbuminuria is a key indicator of how diabetic nephropathy may evolve in individuals with type 2 diabetes. Furthermore, Microalbuminuria is one of the major risk factors for cardiovascular disease in diabetes people. Thus, microalbuminuria is regarded as a crucial treatment target for preventing renal and cardiovascular problems [11]. According to a recent study, individuals with diabetic nephropathy who trained in aerobic exercise had improved renal function and reduced levels of oxidative stress and inflammatory cytokines [12]. Furthermore, a study revealed that those suffering from severe chronic renal dysfunction may benefit from aerobic exercise in their standard of living and renal function. To learn more the efficacy and safety of therapeutic exercise regimens, more research should be done on individuals with late stages of chronic renal disease [13].

According to a recent study, there is an inverse association between diastolic blood pressure and physical activity, and individuals who lead the most active lifestyles also had the lowest rates of hypertension [14]. Additionally, one study found that aerobic exercise training interventions (six months of aerobic training among overweight T2D patients) decreased triglyceride levels (-0.3 mmol/l), total cholesterol (-0.3 mmol/l), systolic blood pressure (-5.6 mmHg), and diastolic blood pressure (-5.5 mmHg). This was based on a meta-analysis involving 1,003 T2D patients [15]. After an 8-week intervention, a different study showed no significant group changes in blood pressure or markers of cardio metabolism in blood such as glycated hemoglobin, fasting glucose, and lipid profiles [16]. A recent study demonstrated that, under the same conditions as the current study, walking exercise (IWT) is more beneficial for improving physical fitness, body composition, and glycemic management than energy expenditure-matched CWT. Patients with type 2 diabetes can also benefit from walking exercise as a free-living training technique [17].

To ensure patient safety, we recommend that exercise regimens focus on simple, low-impact, and moderate-intensity exercises rather than strenuous activities, particularly for individuals with pre-existing conditions or limited physical capacity. Patients should consult healthcare providers to determine the most suitable exercise plan based on their health status.

Conclusion

Patients with diabetic nephropathy who trained in aerobic exercise saw improvements in their renal function as well as a modulation of oxidative stress and inflammatory cytokines. HIIT and MICT have favorable impacts on ACR, blood pressure measurements in systolic and diastolic forms, and HBA1C, besides decreasing the chance of developing cardiovascular disease and improving cardio-metabolic fitness.

Acknowledgment

We express our genuine gratitude to EdigenomiX Scientific Co., Ltd. for their proficient editing and proofreading services, which significantly enhanced the lucidity and excellence of our article. We greatly applaud their fastidious attention to detail and assistance in revising the paper for publication.

Authors' contributions

All authors contributed equally in searching the databases and drafting the manuscript. The authors have read and approved the final manuscript.

Funding

No finding.

Availability of data and material

Not applicable.

Consent for publication

Not applicable.

Conflict of interest

No conflicts of interest.

References

1. Wu J, Feng Z, Duan J, et al. Global burden of type 2 diabetes attributable to non-high body mass index from 1990 to 2019. *BMC Public Health*. 2023; 23: 1338.
2. Pelle MC, Provenzano M, Busutti M, et al. Up-Date on Diabetic Nephropathy. *Life (Basel)*. 2022; 12.
3. Nataraj M, Maiya AG, Nagaraju SP, et al. Effect of exercise on renal function in diabetic nephropathy-a systematic review and meta-analysis. *J Taibah Univ Med Sci*. 2023; 18: 526-37.
4. Tinajero MG, Malik VS. An Update on the Epidemiology of Type 2 Diabetes: A Global Perspective. *Endocrinol Metab Clin North Am*. 2021; 50: 337-55.
5. Taha M, Abdeen H, Abdelsamaia R. High Intensity Interval Versus Continuous Moderate Aerobic Training as a Prophylaxis of Diabetic Nephropathy. *International Journal of*

- Diabetes Research. 2016; 5: 14-9.
6. Sago MK, Gnudi L. Diabetic nephropathy: an overview. *Diabetic nephropathy: methods and protocols*. 2020: 3-7.
 7. de Oliveira Teles G, da Silva CS, Rezende VR, et al. Acute effects of high-intensity interval training on diabetes mellitus: a systematic review. *Int J Environ Res Public Health*. 2022; 19: 7049.
 8. Little JP, Gillen JB, Percival ME, et al. Low-volume high-intensity interval training reduces hyperglycemia and increases muscle mitochondrial capacity in patients with type 2 diabetes. *J Appl Physiol*. 2011; 111: 1554-60.
 9. Hansen D, Dendale P, Jonkers R, et al. Continuous low-to moderate-intensity exercise training is as effective as moderate-to high-intensity exercise training at lowering blood HbA 1c in obese type 2 diabetes patients. *Diabetologia*. 2009; 52: 1789-97.
 10. Cannata F, Vadalà G, Russo F, et al. Beneficial effects of physical activity in diabetic patients. *J funct morphol kinesiol*. 2020; 5: 70.
 11. Araki S-i, Haneda M, Koya D, et al. Reduction in microalbuminuria as an integrated indicator for renal and cardiovascular risk reduction in patients with type 2 diabetes. *Diabetes*. 2007; 56: 1727-30.
 12. Aldahr MHS, Abd El-Kader SM. Impact of exercise on renal function, oxidative stress, and systemic inflammation among patients with type 2 diabetic nephropathy. *Afr Health Sci*. 2022; 22: 286-95.
 13. Calvo-Lobo C, Neyra-Bohorquez PP, Seco-Calvo J. Aerobic exercise effects in renal function and quality of life of patients with advanced chronic kidney disease. *Rev Assoc Med Bras*. 2019; 65: 657-62.
 14. Amanat S, Ghahri S, Dianatinasab A, et al. Exercise and type 2 diabetes. *Physical Exercise for Human Health*. 2020: 91-105.
 15. Syeda UA, Battillo D, Visaria A, et al. The importance of exercise for glycemic control in type 2 diabetes. *American Journal of Medicine Open*. 2023; 9: 100031.
 16. Poon ET-C, Little JP, Sit CH-P, et al. The effect of low-volume high-intensity interval training on cardiometabolic health and psychological responses in overweight/obese middle-aged men. *J Sports Sci*. 2020; 38: 1997-2004.
 17. Karstoft K, Winding K, Knudsen SH, et al. The effects of free-living interval-walking training on glycemic control, body composition, and physical fitness in type 2 diabetic patients: a randomized, controlled trial. *Diabetes Care*. 2013; 36: 228-36.