


Resistance Exercise and Cardiovascular Disease in Diabetes Mellitus

Jin-Hwan Yoon

Department of Sports Science, Hannam University, Daejeon, Korea

Received June 3, 2022
Reviewed June 12, 2022
Accepted June 17, 2022

*Corresponding author
Jin-Hwan Yoon

 <https://orcid.org/0000-0001-9026-6416>

Department of Sports Science, Hannam University, 70 Hannam-ro, Daedeok-gu, Daejeon 34430, Korea
Tel: +82-42-629-7499
Fax: +82-42-629-8402
E-mail: yoonjh@hnu.ac.kr

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease characterized by hyperglycemia and insulin resistance, and it is rapidly emerging as one of the most serious health problems worldwide, including in Korea. The progression of T2DM contributes to the dysfunction of several organs, including the brain, skeletal muscle, liver, kidney, and heart, increasing the risk of various complications.¹

In this issue, I read the article by Kim et al.² with great interest. The authors evaluated the association between changes in physical activity and the risk of major adverse cardiovascular event (MACE) in people with newly diagnosed diabetes using nationwide database in Korea. During the follow-up of 2.3 years, the participants who engaged in sustained physical activity after a diagnosis of diabetes had a 34% lower MACE risk compared to those with sustained inactivity (hazard ratio, 0.66; 95% confidence interval, 0.44–0.98). These results indicate that maintaining active physical activity before and after a diagnosis of diabetes is essential to prevent cardiovascular disease (CVD) in patients with diabetes.

A close relationship exists between T2DM and CVD. T2DM-dependent cardiovascular complications are considered both direct and indirect causes contributing to lower quality of life and greater mortality and morbidity among diabetic patients.³ Indeed, patients with T2DM are reported to have the greater prevalence of CVD

than adults without T2DM, and the risk of CVD increases continuously with rising fasting glucose levels.⁴ In addition, T2DM commonly accompanies other cardiac and metabolic diseases such as hypertension, dyslipidemia, and atherosclerosis, and more than half of T2DM patients tend to be obese. Emerging evidence has shown that both T2DM and obesity are important factors contributing to the progression of CVD.^{5,6}

Given the clinical burden of treating T2DM patients with CVD complications, specific attention on the joint management of T2DM and CVD is warranted. Recent evidence has demonstrated that prolonged poor glycemic control initiates CVD or worsens existing CVD. For this reason, maintaining normoglycemia has been emphasized as a means of preventing and treating CVD after diagnosis of T2DM.⁷ A pharmacological approach is the first line of treatment for glycemic control, but sometimes it is accompanied by unpredictable side effects.

Lifestyle changes such as glycemic control, smoking cessation, diet, and exercise intervention are essential strategies for improving multifactorial T2DM-related risk factors. In particular, exercise training has been recommended as a useful proactive strategy to prevent and even reduce CVD-related risk factors in T2DM patients.^{8,9} Many researchers agree on the beneficial effects of exercise

in the presence of absence of disease and recommend moderate-to-vigorous intensity exercise for at least 150 minutes per week. Aerobic exercise such as walking, swimming, and running appears to exert beneficial effects on vascular dysfunction due to fibrosis, arterial stiffness, and endothelial dysfunction.¹⁰ For these reasons, aerobic exercise may be the most effective approach not only to delay the progression of T2DM but also to prevent primary and secondary CVD.

Improvement of cardiorespiratory fitness and vascular function through aerobic exercise is important for prevention and improvement of CVD in T2DM patients, but in order to maintain aerobic performance and control hyperglycemia, an exercise method that improves whole-body muscle strength may also be required. Resistance exercise is as effective as aerobic exercise for managing both CVD and T2DM,¹¹ which has been confirmed by several meta-analyses and systematic reviews. Resistance exercise may not have a direct effect on the cardiovascular system, but it can reduce hyperglycemia-induced microvascular complications through improvement of glucose metabolism in the skeletal muscle. In addition, resistance exercise has a positive effect on cardiometabolic outcomes such as insulin sensitivity, blood lipid profiles, and blood pressure in T2DM patients,¹²⁻¹⁴ and is a useful means of maintaining vascular function.¹⁵

Therefore, it is necessary to obtain a better understanding of the beneficial effects of resistance exercise and to identify tailored exercise plans that will optimize these benefits. Continuous education on the importance of regular exercise on T2DM-dependent CVD and a combination of resistance and aerobic exercise could improve glycemic control in T2DM. It is necessary to create an environment in which diabetic patients can participate in regular exercise, and to develop various exercise programs considering individual patients' physical fitness level and interest.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

REFERENCES

1. Tonyan ZN, Nasykhova YA, Danilova MM, Glotov AS. Genetics of macrovascular complications in type 2 diabetes. *World J Diabetes* 2021;12:1200-19.
2. Kim D, Seo J, Ha KH, Kim DJ. Maintaining physical activity is associated with reduced major adverse cardiovascular events in people newly diagnosed with diabetes. *J Obes Metab Syndr* 2022;31:187-95.
3. Leon BM, Maddox TM. Diabetes and cardiovascular disease: epidemiology, biological mechanisms, treatment recommendations and future research. *World J Diabetes* 2015;6:1246-58.
4. Singh GM, Danaei G, Farzadfar F, Stevens GA, Woodward M, Wormser D, et al. The age-specific quantitative effects of metabolic risk factors on cardiovascular diseases and diabetes: a pooled analysis. *PLoS One* 2013;8:e65174.
5. American Diabetes Association. 8. Obesity management for the treatment of type 2 diabetes: standards of medical care in diabetes-2020. *Diabetes Care* 2020;43(Suppl 1):S89-97.
6. Iglay K, Hannachi H, Joseph Howie P, Xu J, Li X, Engel SS, et al. Prevalence and co-prevalence of comorbidities among patients with type 2 diabetes mellitus. *Curr Med Res Opin* 2016;32:1243-52.
7. Prattichizzo F, La Sala L, Rydén L, Marx N, Ferrini M, Valensi P, et al. Glucose-lowering therapies in patients with type 2 diabetes and cardiovascular diseases. *Eur J Prev Cardiol* 2019;26(suppl 2):73-80.
8. 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;40:253-71.
9. Way KL, Keating SE, Baker MK, Chuter VH, Johnson NA. The effect of exercise on vascular function and stiffness in type 2 diabetes: a systematic review and meta-analysis. *Curr Diabetes Rev* 2016;12:369-83.
10. Dos Santos Araujo JE, Nunes Macedo F, Sales Barreto A, Viana Dos Santos MR, Antonioli AR, Quintans-Junior LJ. Effects of resistance and combined training on vascular function in type 2 diabetes: a systematic review of randomized controlled trials. *Rev Diabet Stud* 2019;15:16-25.
11. Evans W, Willey Q, Hanson ED, Stoner L. Effects of resistance training on arterial stiffness in persons at risk for cardiovascular disease: a meta-analysis. *Sports Med* 2018;48:2785-95.

12. Wang Y, Yuan XD, Dai X, Li F, Ji H, Lou QQ. Effect of 2-year resistance exercises on cardiovascular disease risk in prediabetes patients. *Zhonghua Nei Ke Za Zhi* 2021;60:22-8.
13. Codella R, Ialacqua M, Terruzzi I, Luzi L. May the force be with you: why resistance training is essential for subjects with type 2 diabetes mellitus without complications. *Endocrine* 2018;62:14-25.
14. Qadir R, Sculthorpe NF, Todd T, Brown EC. Effectiveness of resistance training and associated program characteristics in patients at risk for type 2 diabetes: a systematic review and meta-analysis. *Sports Med Open* 2021;7:38.
15. Huang L, Fang Y, Tang L. Comparisons of different exercise interventions on glycemic control and insulin resistance in prediabetes: a network meta-analysis. *BMC Endocr Disord* 2021;21:181.