Diabetes Mellitus, Physical Exercise and Heart Rate Variability

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Short Editorial related to the article: Effects of High-Intensity Interval Training and Continuous Training on Exercise Capacity, Heart Rate Variability and Isolated Hearts in Diabetic Rats

The prevalence of diabetes mellitus (DM) has grown in recent decades.[1] Risk factors for developing DM have been well established in clinical studies. Among these, sedentary lifestyles, aging and obesity stand out.[2] DM, defined by increased plasma glucose concentration, is commonly accompanied by cardiovascular alterations such as hypertension, coronary disease, heart failure, and cardiac autonomic neuropathy.[3] As cardiovascular diseases are currently the main causes of death and morbidity, studies aimed at better understanding the pathophysiological mechanisms inherent in DM are of great importance.

Cardiac autonomic neuropathy is characterized by changes in fibers that innervate the heart and blood vessels.[4,5] In this condition, changes in nerve function lead to reduced heart rate variability and altered baroreflex sensitivity.[6] Physical exercise is considered an important non-pharmacological therapy to help prevent and control DM and its clinical consequences.[7] Researchers have recently observed that exercise can also prevent and treat cardiac autonomic neuropathy.[7]

Physical exercise increases heart rate variability and improves autonomic function under physiological and pathological conditions.[8] Experimental studies in DM have shown that exercise decreases bradycardia and improves parasympathetic nervous system function.[9,10] However, the effects of exercise on heart rate variability in DM have not been fully clarified. Souza Neto et al.[11] investigated, in diabetic rats, the effects of physical exercise on heart rate variability, functional capacity, and cardiac functional variables obtained in preparations of isolated perfused hearts. The authors used the experimental model of type 1 DM induced by streptozotocin. The animals were subjected to two types of exercise: high-intensity interval training (HIIT), alternating cycles of 1:1 min between 50% and 90% of maximum exercise capacity, and continuous training at 70% of maximum exercise capacity. Rats without DM and rats with DM without training constituted the control groups. Electrocardiograms were recorded for one hour without the restriction of the animals. After 4 weeks, HIIT induced greater improvement in functional capacity than continuous training in control and diabetic rats. Cardiac function was reduced in DM groups and was not influenced by physical exercise. DM groups had lower heart rates than controls, regardless of performance and type of exercise. Despite the lower heart rate in diabetic rats, heart rate variability did not differ between DM and control groups.

As the authors emphasized, the short duration of the study[11] may have been a limitation of the study since effects resulting from DM and physical exercise on heart rate variability could have occurred if there had been a longer observation time.

Controversial results with respect to the literature show the need for additional studies to clarify the effects of high-intensity physical training and continuous training on heart rate variability during DM.

References

1. Tsao CW, Aday AW, Almarzooq ZI, Alonso A, Beaton AZ, Bittencourt MS, et al. Heart Disease and Stroke Statistics-2022 Update: A Report From the American Heart Association. Circulation. 2022;145(8):e153–639.
2. Gimenes R, Gimenes C, Rosa CM, Xavier NP, Campos DHS, Fernandes AAH, et al. Influence of apocynin on cardiac remodeling in rats with streptozotocin-induced diabetes mellitus. Cardiovasc Diabetol. 2018 Jan 17;17(1):15.
3. Ahmad E, Lim S, Lamptey R, Webb DR, Davies MJ. Type 2 diabetes. Lancet (London, England). 2022 Nov 19;400(10365):1803–20.
4. Forbes JM, Cooper ME. Mechanisms of diabetic complications. Physiol Rev. 2013 Jan;93(1):137–88.
5. Vinik AI, Erbas T, Casellini CM. Diabetic cardiac autonomic neuropathy, inflammation and cardiovascular disease. J Diabetes Investig. 2013 Jan;4(1):4–18.
6. Souza SBC, Flues K, Paulini J, Mostarda C, Rodrigues B, Souza LE, et al. Role of exercise training in cardiovascular autonomic dysfunction and mortality in diabetic ovariectomized rats. Hypertens (Dallas, Tex 1979). 2007 Oct;50(4):786–91.

Keywords

Diabetes Mellitus/prevention and control;Exercise; Heart Rate; Risk Factors; Obesity; Sedentary Behavior; Aged.

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DOI: https://doi.org/10.36660/abc.20220902

7. Singleton JR, Smith AG, Marcus RL. Exercise as Therapy for Diabetic and Prediabetic Neuropathy. Curr Diab Rep. 2015 Dec;15(12):120.

8. Grisé KN, Olver TD, McDonald MW, Dey A, Jiang M, Lacefield JC, et al. High Intensity Aerobic Exercise Training Improves Deficits of Cardiovascular Autonomic Function in a Rat Model of Type 1 Diabetes Mellitus with Moderate Hyperglycemia. J Diabetes Res. 2016;2016:1–13.

9. Sanches IC, Conti FF, Bernardes N, Brito J de O, Galdini EG, Cavaglieri CR, et al. Impact of combined exercise training on cardiovascular autonomic control and mortality in diabetic ovariectomized rats. J Appl Physiol. 2015 Sep 15;119(6):656–62.

10. Nakos I, Kadoglou NPE, Gkeka P, Tzallas AT, Giannakeas N, Tsalikakis DG, et al. Exercise Training Attenuates the Development of Cardiac Autonomic Dysfunction in Diabetic Rats. In Vivo. 2018;32(6):1433–41.

11. Souza Neto ED, Peixoto JVC, Rank Filho C, Petterle RR, Fogaça RTH, Wolska BM, et al. Effects of High-Intensity Interval Training and Continuous Training on Exercise Capacity, Heart Rate Variability and Isolated Hearts in Diabetic Rats. Arq Bras Cardiol. 2023; 120(1):e20220396.