

Research Article

Morning and Evening Exercise with or without High-Pressure Intervals have Different Effects on Controlling Blood Sugar and Glucose Fluctuations in People with Type 1 and Type 2 Diabetes

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Abstract

Summary: Exercise is recommended for the treatment and prevention of type 2 diabetes. Also, to control and reduce glucose fluctuations in people with type 1 diabetes. However, the most appropriate time and the most effective intensity of exercise is still unknown, and various studies provide different results and different recommendations, and none of the studies provide a comprehensive and practical result. We conducted our studies to examine the results and determine the effect of time and intensity of exercise on blood sugar control and glucose fluctuations during the day.

Methods: search in PubMed and Google Scholar with keywords morning, evening, type 1 and 2 diabetes, exercise, interval, periodic, aerobic, and glucose and blood sugar fluctuations were performed. A total of 31 articles were reviewed and finally, 10 articles that were most related to each other or had complementary information were selected.

Conclusion: HIIT exercises are useful for type 2 diabetes, but they are recommended for type 1 diabetes with less pressure. Morning exercise increases glucose and evening exercise is applicable for type 1 and 2 diabetes.

Introduction

Diabetes is known as one of the most widespread metabolic diseases, the prevalence of which does not depend on gender and age and is increasing in men, women, children, and adults [1,2]. Due to the beneficial effects of exercise on health and regulation of fuel Physiologists, experts, and doctors recommend exercise to improve homeostasis in the whole body [3] and treat type 2 diabetes [4].

It has also been shown that exercise has beneficial effects on regulating blood sugar and reducing glucose fluctuations in type 1 diabetics [5]. However, so far the recommendations for the best time and the most appropriate intensity of exercise to achieve the beneficial effects of exercise in people with type 1 and 2 diabetes are encouraging.

In terms of time

The circadian clock is a key homeostatic regulator that is coordinated by photonic and nonphotic stimuli (food intake, temperature, and physical activity) and controls many genomic and physiological responses in almost all cells [6]. Morning exercises are exercises that are done in the early hours of the day (6 to 8). These exercises are done close to the time of waking up, and the exercises that are done in the later hours of the day (for example, 10 or 12) are not included in the category of morning exercises. In contrast, evening exercises are performed at the end of the day (usually from 16:00 to 20:00) [7,8]. It has been proven that training time can produce different effects. In mice, the molecular circadian clock in peripheral tissues responds to the time of day of exercise, suggesting that skeletal muscle contraction relays

More Information

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Keywords: Diabetes; Morning training; Evening training; High-pressure interval training; Glucose fluctuations





important information for the synchronization of circadian clocks throughout the body [9]. In human studies, these differences have been repeatedly reported [10]. Caiwei Tian, et al. (2023) conducted a study to clarify the effect of exercise time on the risk of diabetes in 9,3095 people in the United Kingdom. At the end of this research and after reviewing and evaluating the data, they reported their results as follows: Total metabolic equivalents of physical activity in the morning and afternoon had a protective effect on diabetes risk [11].

In terms of intensity: Exercise intensity is usually measured as a percentage of heart rate. Exercises up to 50% of the heart rate are called low-intensity exercises, 70% of the heart beats are called moderate exercises, and more than 90% are called intense and high-pressure exercises. The meaning of high-pressure intervals is the inclusion of high-intensity training for a short period between low-intensity or moderate, which is also called “intense interval training” [12].

There are conflicting data regarding the effect of exercise intensity. To the extent that some consider doing sports exercises such as intense intervals to be dangerous for patients [13] and some studies indicate the beneficial effects of adding high-pressure intervals to continuous aerobic exercises to prevent a rapid drop in blood sugar in type 1 diabetics [10]. Due to conducting research at different times and different exercise intensities, we conducted our study to investigate the effect of exercise time and intensity on controlling blood sugar and glucose fluctuations.

Material and methods

To investigate studies in the field of recognizing the effects of exercise at different times in the morning and evening, as well as the difference between continuous low-intensity aerobic exercises or exercises with high-pressure intervals, from the search in PubMed and Google Scholar in the period from 2016 to 2022 and the words key (diabetes, morning exercise, evening exercise, interval exercise, blood glucose, glucose fluctuations) were used. The language of all studies was English. Studies that used drugs or herbal supplements at the same time, as well as studies that were conducted on professional athletes with diabetes, were excluded. In the end, ten related articles that were most similar in terms of training protocol and subjects or their results were complementary were selected. The results of the studies were examined in terms of the effect of independent variables (exercise type, exercise time) on dependent variables (blood glucose, glucose fluctuations).

Findings

Continuous aerobic exercise with moderate intensity has a high confidence level to recommend to people with type 1 diabetes [14]. However, adding high-pressure intervals to continuous aerobic exercise can prevent premature hypoglycemia [15]. A study on 54 people with type 1 diabetes

and the implementation of continuous moderate-intensity aerobic exercise by adding high-pressure intervals based on heart rate at three levels of 70, 80, and 90% of the maximum heart rate showed that adding high-pressure intervals to high-intensity exercise Moderate may increase the risk of hypoglycemia at higher intensities. However, another study showed that performing high-intensity interval training both in the morning and in the evening can be effective in controlling blood sugar in type 1 diabetics and reduce the frequency of hypoglycemic events after exercise [16].

Regarding the effect of time, it has been reported that morning exercises increase glucose in people with type 1 diabetes [17]. However, it should be noted that people with type 1 diabetes often experience a period of high blood glucose levels in the early morning, commonly referred to as the “dawn phenomenon”, which may be secondary to the effects of exercise. to affect [18]. On the other hand, people who did Trinate with high-pressure intervals (intervals) in the evening had less hyperglycemia than people who did these exercises in the morning (at 7 o'clock), and increased blood sugar peaks that were detected using a 24-hour glucose monitoring device. (CGM) recorded was lower than the morning exercise group and also the control group [16]. However, type 1 diabetics who underwent interval training with high-pressure intervals in the morning (7 o'clock) experienced fewer hypoglycemia events than the control group and the evening exercise group. Moholdt et al. conducted a study on overweight men on a high-fat diet. They compared the differences between morning and evening exercise. In the results of this study, it has been reported that fasting blood glucose, insulin, cholesterol, triacylglycerol, and LDL-cholesterol concentrations were reduced only in the participants who were assigned to exercise at night [7]. It is interesting to note that according to the information obtained from the CGM device, the highest drop in blood sugar in type 1 diabetics who participated in the evening exercise occurred in the early morning of the next day. However, people who exercise in the morning, have experienced less hypoglycemia, but most of these incidents occurred in the middle of the night [16], which seems to have more risks for the individual [19].

The current studies showed that adding high-pressure intervals to endurance training and performing interval training is more effective in improving the blood sugar status of diabetics, however, intense intervals “close to 90% of the heart rate” are not recommended for people with type 1 diabetes. It was also shown that doing interval training in the morning increases blood sugar, so evening exercises seem better for people with type 2 diabetes because they will experience fewer blood sugar fluctuations. However, people with type 1 diabetes had more hypoglycemia incidents in the evening exercises than in the morning exercises, which seems to be more suitable for these people to choose interval training in the morning than in the evening. It can be emphasized that doing exercises in the morning has caused hypoglycemia incidents at night, which should be taken into consideration.



Of course, in the case of prior knowledge, this issue can be prevented for people.

These results emphasize the importance of choosing the right time and intensity to achieve the beneficial effects of exercise in diabetic people. However, due to the limitations of human research in the field of diabetes, most studies have been conducted in short periods and with a small number of subjects. Considering the existence of individual differences as well as the difference between people in terms of the progress of the disease and also the existence of different responses to exercise, it seems that there is a need for more extensive research in this field with more subjects and in a longer period.

Conclusion

According to the studies conducted in this study, it is possible to recommend intermittent exercises with intense intervals to control blood sugar and reduce glucose fluctuations for type 2 diabetes. However, in the case of type 1 diabetes, doing intense exercises does not seem appropriate. Evidence also shows that insulin sensitivity is lower in the morning than in the afternoon in people with diabetes [20] and there is less suppression of endogenous glucose production [21]. In general, morning exercises should be done with caution even for people with type 2 diabetes, but evening exercises are useful for people with type 1 and type 2 diabetes. However, it seems that more studies on larger samples are needed to be able to recommend the best program in terms of training intensity and training time.

References

1. Sheikh R, Shakerian S, Tabatabaei SRF, Habibi A. Moderate, and high-intensity interval training protect against diabetes-induced modulation of hepatic CD86 and CD206 expression associated with the amelioration of insulin resistance and inflammation in rats. *Immunobiology*. 2023; 228(6):152745.
2. Jusup SA, Douwes M, Purwanto B, Indarto D. Effect of Morning and Afternoon Exercise on the Improvement of Endothelial Dysfunction in Type-2 Diabetes Mellitus Patients.
3. Sheikh R, Nikbakht M. Physical activity and apoptosis, a brief review of previous findings. *Sport Sciences and Health Research*.
4. Sheikh R, Gallehdari M. The effect of herbal supplement and exercise training on plasma lipid profile in diabetic male rats. *Journal of Exercise & Organ Cross Talk*. 2023; 3(2):86-92.
5. Soleimani N, Gallehdari M, Sheikh R. Effect of six weeks of interval training and curcumin consumption on apolipoprotein A and B in diabetic male rats. *Journal of Exercise & Organ Cross Talk*. 2023; 3(2):73-80.
6. Gabriel BM, Zierath JR. The Limits of Exercise Physiology: From Performance to Health. *Cell Metab*. 2017 May 2;25(5):1000-1011. doi: 10.1016/j.cmet.2017.04.018. PMID: 28467920.
7. Moholdt T, Parr EB, Devlin BL, Debik J, Giskeødegård G, Hawley JA. The effect of morning vs evening exercise training on glycaemic control and serum metabolites in overweight/obese men: a randomised trial. *Diabetologia*. 2021 Sep;64(9):2061-2076. doi: 10.1007/s00125-021-05477-5. Epub 2021 May 19. PMID: 34009435; PMCID: PMC8382617.
8. Fasipe B, Laher I. Nrf2 modulates the benefits of evening exercise in type 2 diabetes. *Sports Med Health Sci*. 2023 Sep 9;5(4):251-258. doi: 10.1016/j.smhs.2023.09.001. PMID: 38314046; PMCID: PMC10831386.
9. Wolff G, Esser KA. Scheduled exercise phase shifts the circadian clock in skeletal muscle. *Med Sci Sports Exerc*. 2012 Sep;44(9):1663-70. doi: 10.1249/MSS.0b013e318255cf4c. PMID: 22460470; PMCID: PMC3414645.
10. Brooker PG, Gomersall SR, King NA, Leveritt MD. The feasibility and acceptability of morning versus evening exercise for overweight and obese adults: A randomized controlled trial. *Contemp Clin Trials Commun*. 2019 Jan 11;14:100320. doi: 10.1016/j.conctc.2019.100320. PMID: 30705992; PMCID: PMC6348200.
11. Tian C, Bürki C, Westerman KE, Patel CJ. Association between timing and consistency of physical activity and type 2 diabetes: a cohort study on participants of the UK Biobank. *Diabetologia*. 2023 Dec;66(12):2275-2282. doi: 10.1007/s00125-023-06001-7. Epub 2023 Sep 20. PMID: 37728730; PMCID: PMC10628002.
12. D'Haese S, Verboven M, Evens L, Deluyker D, Lambrechts I, Eijnde BO, Hansen D, Bito V. Moderate- and High-Intensity Endurance Training Alleviate Diabetes-Induced Cardiac Dysfunction in Rats. *Nutrients*. 2023 Sep 12;15(18):3950. doi: 10.3390/nu15183950. PMID: 37764732; PMCID: PMC10535416.
13. Ahmadi S, Sheikh R. Effect of incremental interval training on levels of FasI protein in lung tissue of mature male Wistar rats: Does exercise training reduce lung inflammation? *Journal of Exercise & Organ Cross Talk*. 2023; 3(2):66-72.
14. Syahputra M, Lindarto D, Ramayani OR, Machrina Y, Purba A, Putra IB, Nasution IPA, Harahap J. Effect of Moderate Intensity Continuous Training and Slow Type Interval Training to Gene Expression of TGF- β in Type 2 Diabetes Mellitus Model Wistar Rats. *Med Arch*. 2023 Feb;77(1):4-7. doi: 10.5455/medarh.2023.77.4-7. PMID: 36919130; PMCID: PMC10008258.
15. Findikoglu G, Altinkapak A, Yaylali GF. Is isoenergetic high-intensity interval exercise superior to moderate-intensity continuous exercise for cardiometabolic risk factors in individuals with type 2 diabetes mellitus? A single-blinded randomized controlled study. *Eur J Sport Sci*. 2023 Oct;23(10):2086-2097. doi: 10.1080/17461391.2023.2167238. Epub 2023 Feb 5. PMID: 36622777.
16. Toghi-Eshghi SR, Yardley JE. Morning (Fasting) vs Afternoon Resistance Exercise in Individuals With Type 1 Diabetes: A Randomized Crossover Study. *J Clin Endocrinol Metab*. 2019 Nov 1;104(11):5217-5224. doi: 10.1210/je.2018-02384. PMID: 31211392.
17. Turner D, Gray BJ, Luzio S, Dunseath G, Bain SC, Hanley S, Richards A, Rhydderch DC, Ayles M, Kilduff LP, Campbell MD, West DJ, Bracken RM. Similar magnitude of post-exercise hyperglycemia despite manipulating resistance exercise intensity in type 1 diabetes individuals. *Scand J Med Sci Sports*. 2016 Apr;26(4):404-12. doi: 10.1111/sms.12472. Epub 2015 Apr 28. PMID: 25919405.
18. Takayoshi T, Hirota Y, Yamamoto A, Yoshimura K, Nishikage S, Ueda M. Impact of early-morning administration of rapid-acting insulin on the increase in blood glucose levels related to the dawn phenomenon in individuals with type 1 diabetes. *Diabetology International*. 2024:1-6.
19. Yardley JE, Kenny GP, Perkins BA, Riddell MC, Balaa N, Malcolm J, Boulay P, Khandwala F, Sigal RJ. Resistance versus aerobic exercise: acute effects on glycemia in type 1 diabetes. *Diabetes Care*. 2013 Mar;36(3):537-42. doi: 10.2337/dc12-0963. Epub 2012 Nov 19. PMID: 23172972; PMCID: PMC3579339.
20. Schiavon M, Dalla Man C, Kudva YC, Basu A, Cobelli C. Quantitative estimation of insulin sensitivity in type 1 diabetic subjects wearing a sensor-augmented insulin pump. *Diabetes Care*. 2014;37(5):1216-23. doi: 10.2337/dc13-1120. Epub 2013 Dec 6. PMID: 24319120; PMCID: PMC3994930.
21. Hinshaw L, Dalla Man C, Nandy DK, Saad A, Bharucha AE, Levine JA, Rizza RA, Basu R, Carter RE, Cobelli C, Kudva YC, Basu A. Diurnal pattern of insulin action in type 1 diabetes: implications for a closed-loop system. *Diabetes*. 2013 Jul;62(7):2223-9. doi: 10.2337/db12-1759. Epub 2013 Feb 27. PMID: 23447123; PMCID: PMC3712033.