International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Review Article

Exercise and Type 2 Diabetes: A Mini Review

Faisal Suleh Hayyat

Department of Physical Education and Sports Science, Annamalai University, Annamalai Nagar, Chidamaram, Tamilnadu, India.

Corresponding Author: Faisal Suleh Hayyat

ABSTRACT

The type 2 diabetes is one of the major causes of deaths worldwide. Type II diabetes is a major risk factor for vascular disease with 65% of all diabetic deaths being due to cardiovascular disease. The aim of this study is to review the relevant evidence on the interrelationships between exercise and type II diabetes. The review has shown the effect of exercise on the control of type II diabetes, being suggested as one of the finest kinds of non-pharmacological treatments. Here, we present recent findings suggesting the benefits of exercise against type II diabetes.

Key words: Exercise; Type II diabetes.

INTRODUCTION

Diabetes has turned out to be an extensive pandemic, mainly because of the rising dominance and occurrence of type II diabetes. Physical activity along with diet and medicine is well thought-out as elementary in the handling of diabetes; many with this chronic disease do not remain recurrently active. Studies establishing the significance of exercise and fitness in diabetes were missing until recent times, but it is now well known that involvement in regular physical activity improves blood glucose control and can prevent or delay type II diabetes, along with positively disturbing lipids, blood pressure, cardiovascular events, mortality, and quality of life. [1] Type II diabetes is an important reason for early transience and morbidity linked to cardiovascular disease (CVD), blindness, kidney and nerve disease, and amputation. [2] Regular physical activity (PA) may avert or holdup diabetes and its complications. [3] However, the terms ‘‘physical activity’’ and ‘‘exercise’’ point to two different concepts. ‘‘Physical activity’’ refers to any bodily movement produced by skeletal muscles that results in an expenditure of energy (expressed in kilocalories) and includes a expansive array of job-related, leisure and daily activities. ‘‘Exercise’’ refers to intended or prearranged physical activity. It involves repetitive bodily movements performed to perk up or keep up one or more of the components of physical fitness: aerobic capacity (or endurance capacity), muscular strength, muscular endurance, flexibility and body composition. Therefore, not only the role of physical activity, but also of exercise has long been documented in the management procedure of type 2 diabetics which results in a range of physiological and metabolic adaptations. [4]

In this editorial, the broader term “physical activity” is used interchangeably with “exercise,” which is defined as “a detachment of PA done with the goal of

developing physical fitness." The goal is to be aware of that several types of physical movement may have an optimistic effect on physical fitness, morbidity, and mortality in folks with type 2 diabetes.

METHODOLOGY

An extensive review of literature was made between 2010 and 2018 via electronic search using Pubmed, Scopus, Web of Science, Science Direct, J-Gate, Google Scholar and a library search for articles published in peer-reviewed journals, unpublished materials, thesis and other scientific database sites. The literature cited in this review dated from 1960 to 2017.

The effects of exercise on type II diabetes

Resistance exercise has not been as beneficial as aerobic exercise which is evident from in-depth studies and only in the recent past has been documented as a valuable therapeutic training procedure for the treatment of various chronic diseases, the diminution of numerous cardiovascular risk factors as well as the improvement of insulin action on tissue, leading to prevention and treatment of type II diabetes. Special effects of aerobic exercise and resistance exercise on patients with type II diabetes are offering different conclusions. Exercise interventions were normally set up to diminish glycosylated hemoglobin (HbA1c) although of late the effects on other parameters, such as % $VO2_{max,}$ insulin, plasma glucose, changes in protein contents of GLUT4, PKB, visceral and subcutaneous fat and carnitine, were reported with post and pre-training. [4] However the synergistic and incremental effect of resistance and aerobic training offers a glycemic control in persons with type II diabetes. [5] There is good evidence that resistance training improves insulin sensitivity and glucose tolerance and therefore seems to be an effective measure to improve overall metabolic health and reduce metabolic risk factors in diabetic patients. [6]

A single session of exercise can promote beneficial effects regarding blood pressure control, glycemia, carbohydrate oxidation during exercise and fat oxidation after exercise. Evidence has shown that exercise, especially at intense domains, can increase the bioavailability of nitric oxide, promoting a decrease in blood pressure after exercising. Furthermore, metabolic stress from exercising is able to increase the oxidation of carbohydrates during exercise, keeping an elevated O2 consumption after exercising. This, in consequence, increases fat oxidation during at rest and improves glucose tolerance, insulin sensibility and can reduce glucose levels between 2 to 72 h depending of intensity and duration of the effort. [7]

Regular exercise improves metabolic markers and has anti-inflammatory properties. Exercise may mediate its anti-inflammatory effects directly with each bout of exercise or indirectly via long-term metabolic improvements in e.g. body composition, physical fitness, lipid and glucose metabolism. These anti-inflammatory properties of exercise might be a common denominator for the protective effect of exercise on chronic diseases such as type II diabetes. [8,9] Exercise induced GlycA reductions also reflects a reduced risk of developing type II diabetes and diabetes-associated cardiometabolic complications for a number of inflammatory conditions. [10]

Supervised exercise training results in substantial response variations in glucose homeostasis, insulin sensitivity, and muscle mitochondrial density, wherein approximately 15–20% of individuals fail to improve their metabolic health with exercise. Classic genetic studies have shown that the extent of the exercise training response is largely heritable, whereas new evidence demonstrates that DNA hypomethylation is linked to the exercise response in skeletal muscle. DNA sequence variation and/or epigenetic modifications may, therefore, dictate the exercise training response. [11]

White adipose tissue plays a role in lipid storage, hormone production, immune function, and local tissue architecture and is

classified into two major depots: visceral white adipose tissue and subcutaneous white adipose tissue. An accumulation of visceral white adipose tissue is associated with insulin resistance, an increased risk of type II diabetes and mortality, whereas an accumulation of subcutaneous white adipose tissue is associated with improved insulin sensitivity and a reduced risk for developing type II diabetes. Stanford et al., [12] reported that exercise training results in profound changes to white adipose tissue, including increased expression of genes involved in mitochondrial biogenesis, increased mitochondrial activity, increased begging of subcutaneous white adipose tissue, and an altered adipokine profile of white adipose tissue. Cassidy et al., [13] demonstrated that exercise interventions shows improvements in cardiac structure and function, along with the greatest reduction in liver fat in type 2 diabetes.

Both aerobic and resistance exercises and their combination promote significant health benefits in subjects with type II diabetes. Aerobic exercise interventions have a clinically significant effect on VO2max, with higher-intensity exercise providing additional benefits on cardiorespiratory fitness and metabolic control. Resistance exercise improves insulin sensitivity and glucose tolerance, while improving lean body mass and strength parameters. Both forms of exercise and their combination can assist with management of blood glucose levels, lipids, blood pressure, cardiovascular risk, mortality and quality of life. In order to be effective, exercise must be undertaken regularly and most people with type II diabetes can exercise safely. [4] However single high intensity resistance exercise session was able to reduce blood glucose and improve insulin sensitivity. These evidences suggest that high intensity resistance exercise can be a promising non-pharmacological tool in the prevention and control of blood glucose in people with insulin resistance and type II diabetes. [14,15]

In this regard a Position Statement of the American Diabetes Association clearly address that Physical activity and exercise should be recommended and prescribed to all individuals with diabetes as part of management of glycemic control and overall health. Specific recommendations and precautions will vary by the type of diabetes, age, activity done, and presence of diabetes-related health complications. Recommendations should be tailored to meet the specific needs of each individual. In addition to engaging in regular physical activity, all adults should be encouraged to decrease the total amount of daily sedentary time and to break up sitting time with frequent bouts of activity. Behavior-change strategies can be used to promote the adoption and maintenance of lifetime physical activity. [16]

CONCLUSIONS

Although the beneficial effects of exercise, as reviewed in the current paper, are well established, the long-term outcome of exercise interventions in T2DM patients is largely unknown. Studies indicate that increased levels of physical activity and increased physical fitness level show improvements. However, while waiting for the outcome of such a study, it should be emphasized that physical activity represents a natural with minor side effects.

Disclosure of interest

The authors declare that they have no competing interest.

REFERENCES

1. S. Zanuso, A. Jimenez, G. Pugliese, G. Corigliano, S. Balducci, Exercise for the management of type 2 diabetes: a review of the evidence, Acta Diabetol. 2010 (1) 15-22.
2. U.S. Department of Health and Human Services Centers for Disease Control and Prevention. National Diabetes Fact Sheet: General Information and National Estimates on Diabetes in the United States, 2007. Atlanta (GA): U.S. Department of Health and Human Services Centers for Disease Control and Prevention; 2008.

3. S.R. Colberg, R.J. Sigal, B. Fernhall et al., Exercise and Type 2 Diabetes: The American College of Sports Medicine and the American Diabetes Association: joint position statement, Diabetes Care. 2010 (12) e147-e167.
4. S. Zanuso, A. Jimenez, G. Pugliese, G. Corigliano, S. Balducci, Exercise for the management of type 2 diabetes: a review of the evidence, Acta Diabetol. 2010 (1) 15-22.
5. R.J. Sigal, G.P. Kenny, N.G. Boule, G.A. Wells, D. Prud'homme, M. Fortier, R.D. Reid, H. Tulloch, H. Coyle, P. Phillips, A. Jennings, J. Jaffey, Effects of aerobic training, resistance training, or both on glycemic control in Type 2 diabetes, Ann Intern Med. 2007 (147) 357–369.
6. B. Strasser, D. Pesta, Resistance training for diabetes prevention and therapy: experimental findings and molecular mechanisms, Biomed Res Int. 2013 (2013) 1–8.
7. R.Y. Asano, M.M. Sales, R.A.V. Browne et al., Acute effects of physical exercise in type 2 diabetes: A review, World Journal of Diabetes. 2014 (5) 659-665.
8. K. Karstoft, B.K. Pedersen, Exercise and type 2 diabetes: focus on metabolism and inflammation, Immunol Cell Biol. 2016 (2) 146-50.
9. M. Krause, T.G. Heck, A. Bittencourt et al., "The Chaperone Balance Hypothesis: The Importance of the Extracellular to Intracellular HSP70 Ratio to Inflammation-Driven Type 2 Diabetes, the Effect of Exercise, and the Implications for Clinical Management," Mediators of Inflammation. 2015 (12) 249205.
10. D.B. Bartlett, C.A. Slentz, M.A. Connelly, L.W. Piner, L.H. Willis, L.A. Bateman, E.O. Granville, C.W. Bales, K.M. Huffman, W.E. Kraus, Association of the Composite Inflammatory Biomarker GlycA, with Exercise-Induced Changes in Body Habitus in Men and Women with Prediabetes, Oxid Med Cell Longev. 2017 5608287.
11. N.A. Stephens, L.M. Sparks, Resistance to the beneficial effects of exercise in type 2 diabetes: are some individuals programmed to fail, J Clin Endocrinol Metab. 2015 (1) 43-52.
12. K.I. Stanford, R.J. Middelbeek, L.J. Goodyear, Exercise Effects on White Adipose Tissue: Beiging and Metabolic Adaptations, Diabetes. 2015 (7) 2361-8.
13. S. Cassidy, C. Thoma, K. Hallsworth, J. Parikh, K.G. Hollingsworth, R. Taylor, D.G. Jakovljevic, M.I. Trenell, High intensity intermittent exercise improves cardiac structure and function and reduces liver fat in patients with type 2 diabetes: a randomised controlled trial, Diabetologia. 2016 (1) 56-66.
14. S.K. Malin, C.A. Rynders, J.Y. Weltman, E.J. Barrett, A. Weltman, Exercise Intensity Modulates Glucose-Stimulated Insulin Secretion when Adjusted for Adipose, Liver and Skeletal Muscle Insulin Resistance, PLoS ONE. 2016 (4) e0154063.
15. J.E.D.S. Araújo, S.R.M. Dos, S.L. Santos, R.J.S. Silva, A.C. Marçal, Effects of high intensity acute resistance exercise on blood glucose and insulin sensitivity in rats with insulin resistance, Journal of Physical Education. 2016 (27) e2735.
16. S.R. Colberg, R.J. Sigal, J.E. Yardley, M.C. Riddell, D.W. Dunstan, P.C. Dempsey, E.S. Horton, K. Castorino, D.F. Tate, Physical Activity/Exercise and Diabetes: A Position Statement of the American Diabetes Association, Diabetes Care. 2016 (11) 2065-2079.

How to cite this article: Hayyat SF. Exercise and type 2 diabetes: a mini review. Int J Health Sci Res. 2018; 8(9):235-238.

******