

Review Article

A comprehensive review on the role of yoga in the management of type-2 diabetes mellitus and its benefits over physical exercise in type 2 DM

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ABSTRACT

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia. It is caused either due to defective secretion of insulin or due to increased insulin resistance of peripheral tissue. The incidence of DM has increased in past decade due to sedentary lifestyle, altered dietary patterns, obesity etc. DM increases morbidity and mortality of individuals, thereby requiring great attention. In recent era, insulin and oral hypoglycemic agents are used in majority to treat DM. Recent studies have shown that simple lifestyle changes like dietary changes, yoga and physical exercise are highly beneficial in reducing the burden of disease. This review focusses on yoga as an intervention in reducing the morbidity from the disease. It highlights the benefits of yoga over physical exercise in halting the progress of disease. Physical exercise is not feasible in patients with obesity, cardio vascular diseases and older age group. Yoga is a physical, psychological and spiritual intervention that is more feasible than physical exercise.

Keywords: Yoga, Diabetes mellitus, Physical exercise, Reactive oxygen species

INTRODUCTION

Diabetes mellitus (DM) is a chronic disorder which is manifested as hyperglycemia. Interaction between various genetic and environmental mental factors plays a role in the pathogenesis of DM. On the basis of the pathogenic process that leads to DM, it is classified as type 1 and 2 DM. Autoimmune destruction of the beta cells in the pancreatic islets leads to Type 1 DM or insulin-dependent diabetes mellitus (IDDM), which accounts for 3-5% of cases, especially in children. Type 2 DM or non-insulin dependent DM (NIDDM), is primarily due to dysregulation of insulin release from beta cells, along with insulin resistance in peripheral tissues such as skeletal muscle, brain, and liver. Type 2 DM is predominant in overweight or obese adults, although it is increasingly being diagnosed in children due to childhood obesity increases. Though diabetes is a glycemic disorder, it is a compound condition characterized by many underlying metabolic abnormalities. These disorders, comprising insulin resistance or metabolic syndrome, predict the

development of diabetes mellitus in the future. The main characteristics of insulin resistance syndrome (IRS) are glucose intolerance, insulin resistance and atherogenic dyslipidemia.¹

Other conditions associated with IRS that lead to progression of DM are hypercoagulation, chronic inflammation, endothelial dysfunction and oxidative stress. Bad management of both forms of diabetes will produce complications due to microvascular angiopathy (such as blindness, renal failure, or polynephropathy), and macrovascular angiopathy (gangrene and amputation, aggravated coronary heart disease, or stroke) which can lead to chronic morbidities and mortalities. Thus, proper management of DM is of utmost importance. The greatest challenge healthcare providers today facing is satisfying the increasing needs and demands of individuals with chronic disorders like diabetes. The primary goal of treatment of DM is the maintenance of normoglycemia to prevent the onset, delay the progression and prevent long-term complications. Conventional medicine for diabetes

aims to regulate blood glucose with a combination of dietary changes, exercising regularly, maintaining ideal body weight, insulin and oral agents and self-monitoring blood glucose levels. Due to the potential threat to the quality of life and the chronic nature of diabetes many people prefer complementary therapies and alterations to control the disease.⁵ Some of them are dietary supplements, acupuncture, massage therapy, hydrotherapy, medicinal herbs, physical exercise, and yoga.⁶ Exercise in diabetes patients can improve insulin sensitivity, blood glucose, and lipid profile. However, the level of exercise recommended to NIDDM patients for controlling plasma glucose level, decreasing obesity and improving insulin sensitivity is 50%-70% of maximum aerobic capacity lasting 30 minutes, three or five times a week is not feasible in many patients because of age, obesity, cardiovascular diseases, and other problems.⁷

Yoga is an old, Indian psychological, physical, and spiritual exercise regimen that has been known for several decades for its role in the management of several chronic diseases like hypertension, asthma, obesity, neuromuscular diseases, and psychiatric illness.⁵ Yoga practices commonly include asanas (physical posture), pranayama (regulated breathing), and meditation. It is a cost-effective prevention and management strategy for DM type 2. It plays a vital role in stress management and the reduction of negative emotional states in order to reduce the burden of disease.

This review article mainly focuses on determining the effect of practicing yoga on people suffering from type 2 DM and highlighting its benefits over physical exercise in type 2 DM.

EPIDEMIOLOGY

The increase in incidence and prevalence of type 2 DM has occurred globally, but has been more evident in developing countries, newly industrialized countries, and in societies in economic transition. In the year 2014, the number of cases of diabetes worldwide is estimated to be around 422 million, of these more than 90% are type 2 DM. In 2016, around 1.6 million people died from the outcome of high blood sugar.²

More than 80% of diabetes deaths occur in low- and mediocre-income countries due to poor management. The global prevalence of diabetes was estimated to be 8.5% in adults aged 18+ years in 2014.² The occurrence of DM is highest in the Eastern Mediterranean region and region of the Americas and lowest in the European and Western Pacific Regions. Low-income countries showed the lowest prevalence and upper- middle-income countries showed the highest.³

Alterations of lifestyle and dietary habits that are associated with urbanization are believed to be the most important factors leading to diabetes type 2. Overweight

and obesity are the 5th leading risk of global deaths. In 2016, more than 1.9 billion adults, 18 years and older, were overweight.⁴ This increases the necessity of physical exercise and other intervention measures among the population for a sustainable lifestyle.

PATHOPHYSIOLOGY

Insulin resistance and abnormal insulin secretion are important causes of development of type 2 DM. One of the most important predisposing factors of type 2 DM is obesity. Insulin helps in glucose uptake in skeletal muscle and adipose tissue by causing translocation of GLUT 4 receptors to plasma membrane. It lowers plasma glucose levels by promoting glycogen synthesis in liver and other metabolic process. Thus, it plays a vital role in glucose homeostasis. Although the mechanism linking obesity to insulin resistance is under research, it has been stated that adipose tissue modulates metabolism by releasing non-esterified fatty acids, glycerol, leptins, adiponectin, and proinflammatory cytokines. In obesity, the production of these products is increased which may lead to insulin resistance.⁸

The pancreatic cells compensate insulin resistance in the initial stages of the disorder, thereby maintaining normal glucose tolerance. But as the disease progresses, the pancreatic cells cannot sustain the compensation leading to decreased insulin release and fasting hyperglycemia.

MECHANISM OF EXERCISE-INDUCED CHANGES IN TYPE 2 DM

The uptake of glucose into skeletal muscle fibers occurs by facilitated transport through GLUT4. A single round of physical activity leads to increased uptake of glucose by skeletal muscle fibers. This increase occurs as a result of translocation of the GLUT4 from intracellular sites to sarcolemma and T tubules. While performing physical exercise, there is increased activity of AMP-activated protein kinase (AMPK) which results in phosphorylation of the Rab-GTPase-activating protein TBC1D1. This phosphorylation leads to the inactivation of TBC1D1, enabling GTP to react with Rab proteins on the GLUT4 vesicles. This results in the translocation of GLUT4 vesicles to the plasma membrane and glucose uptake into the cell.

Prolonged physical activity also results in a shift in fuel usage by working muscle from free plasma glucose to muscle glycogen and fatty acids.⁹ It is a well-established fact that physical activity helps in weight loss and maintaining ideal BMI. This helps in the improvement of obesity-related health conditions, including cardiovascular diseases and type 2 DM. Exercise training helps in burning ectopic fat, including white adipose tissue and fat stores in the liver, thereby reducing the risk of developing type 2 DM.¹⁰

PHYSIOLOGY OF YOGA

The foundations of yoga dates back to thousands of years. When done properly, yoga has both psychological and physiological benefits. It is of various types like- Vinayasa yoga, Hatha yoga, Iyengar yoga, Kundalini yoga, Ashtanga yoga, Bikram yoga, Yin yoga, Restorative yoga, Prenatal yoga, Anusara yoga, and Jivamukti yoga which bring balance and health to the physical, mental, emotional and spiritual dimensions of an individual.¹¹ Recent studies have supported that yoga helps in maintaining physical and mental health by down- regulation of sympathetic nervous system (SNS) and hypothalamic-pituitary-adrenal axis

(HPA axis). The SNS and HPA axis are elicited as a response to physical or psychological stress, leading to a cascade of physiologic, behavioral, and psychologic effects, primarily due to release of catecholamines (epinephrine and norepinephrine) and cortisol. This response leads to utilization of energy for combating stress and initiates the ‘flight or fight’ syndrome. Repeated activation of the SNS and HPA axis leads to improper regulation of the system and finally disorders like obesity, diabetes, hypertension, depression, cardio-vascular diseases, etc.¹²

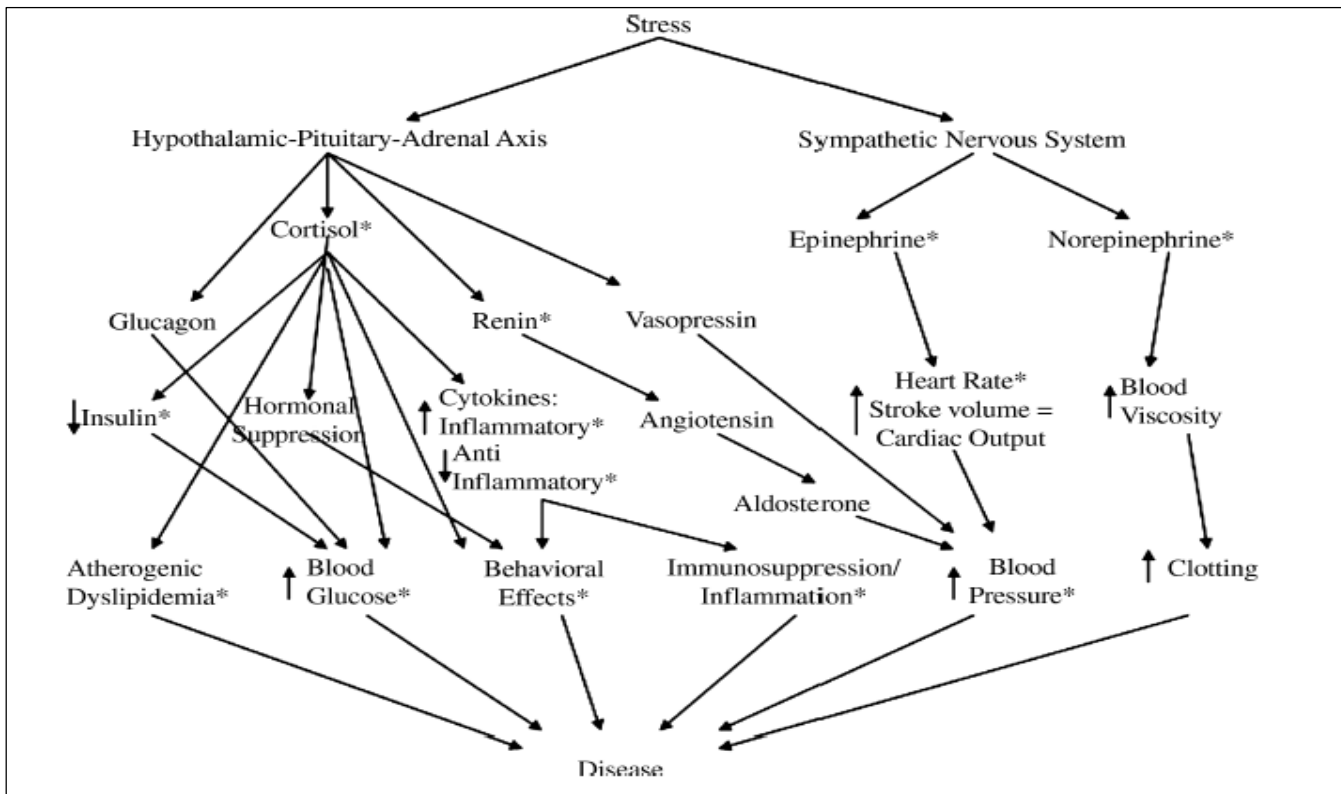


Figure 1: The effect of stress on SNS and HPA axis.¹²

*Yoga has been beneficial in the selected aspects.

Although the mechanism behind this phenomenon is still under research, it has been hypothesized that yoga causes a shift towards parasympathetic nervous system dominance by vagal stimulation. Thus, yoga helps in countering many effects of the sympathetic nervous system. It lowers the blood glucose level, reduces blood pressure and heart rate which help in managing chronic disorders like diabetes, hypertension, and cardiovascular diseases.

METHODS

Studies that had yoga as an intervention for managing DM type 2 were included in the review. Electronic databases like PubMed, google scholar, and Cochrane library were searched for the purpose of the review. Search terms used are “yoga and diabetes mellitus”, “yoga and DM type 2”,

“diabetes mellitus management”, “benefits of yoga” and “yoga practices and metabolic disorders”.

Results obtained were as mentioned in Table 1.

BENEFITS OF YOGA OVER PHYSICAL EXERCISE

Although both yoga and physical exercise are highly beneficial to health, yoga has many advantages over exercise in various aspects. Yoga is more feasible than physical exercise. Humans always produce free radicals as a part of normal metabolic processes. Reactive oxygen species (ROS) are free radicals that are derivatives of oxygen. Organisms are equipped with antioxidants to combat the harmful effects of free radicals.¹³ Disturbance in oxidation-reduction balance in favor of oxidants,

resulting in disruption of redox signaling or molecular damage is termed oxidative stress. Studies have shown that chronic oxidative stress is involved in the pathogenesis of various diseases including DM. Studies conducted since the 1990s have reported that acute aerobic exercise increases the level of markers of oxidative damage of lipids, proteins, and DNA. Thus, acute aerobic exercise increases oxidative stress and can have a damaging effect

on the human body.¹⁴ High intensity and long-term endurance exercise puts excessive stress on the circulatory system. A study done on marathon runners found that even after finishing intense running events, athletes' blood samples contain biomarkers associated with heart and renal damage.¹⁵ Yoga has not shown any such adverse effects on research and can be considered beneficial over physical exercise.

Table 1: Effect of yoga on DM type 2 seen in various studies.

Author	Year	Population (N)	Activity type	Duration	Outcome
Malhotra et al	2005	20 men and women of age 30-60 years	Yoga asanas	40 days	Decreased body weight, reduced fasting blood glucose (FBG), increased serum insulin.
Kumaran et al	2015	30 male diabetic patients and 30 male non-diabetic people of age 36-55 years	Yoga asanas and pranayama	6 months	Reduced FBG and postprandial blood glucose (PPBG).
Malhotra et al	2004	4 men and 34 women of NIDDM (30-60 years)	Yoga asanas and pranayama	40 days	Reduced FBG, PPBG, HbA1, total serum cholesterol, triglycerides (TGA), LDL and VLDL
Singh et al	2001	19 men and women of NIDDM (30-60 years)	Yoga asanas	40 days	Reduced FBG, PPBG, HbA1, Malondialdehyde (MDA)
Sridhar et al	2009	24 men and 11 women of NIDDM (42-58 years)	Yoga asanas and pranayama	40 days	Reduced BMI, depression, and anxiety. Increased energy and positive well-being.
Sharma et al	2016	20 of age group 17-21 years	Yoga asanas and pranayama	30 days	Reduce FBG and diastolic blood pressure (DBP)
Thind et al	2018	60 with NIDDM	Yoga asanas and exercise control intervention	12 week or	Reduced FBG, PPBG, and HbA1.

CONCLUSION

Yoga is an age-old tradition that has been practiced for hundreds of years. In the view of people embracing a sedentary life-style, and the effectiveness of the treatment is less, the role of yoga seems to be beneficial and economically adjuvant in managing type 2 DM. It has many benefits over strenuous physical exercise and it is undemanding. Although it has many effects and benefits, most of them are short-term. Practicing yoga along with proper medication is a perfect way of managing DM type 2.

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REFERENCES

- Innes KE, Vincent HK. The influence of yoga-based programs on risk profiles in adults with type 2 diabetes mellitus: a systematic review. *Evid Based Complement Alternat Med.* 2007;4(4):469-86.
- WHO. Diabetes fact sheet, 2018. Available at: <https://www.who.int/newsroom/factsheets/detail/diabetes>. Accessed on 08 June 2020.
- WHO. Global status report on noncommunicable diseases, 2010. Available at: <https://apps.who.int/iris/handle/10665/>. Accessed on 08 June 2020.
- WHO. Blindness and vision impairment, 2021. Available at: <https://www.who.int/newsroom/factsheets/detail/blindness-and-visual-impairment>. Accessed on 08 June 2020.
- Aljasir B, Bryson M, Al-Shehri B. Yoga Practice for the Management of Type II Diabetes Mellitus in Adults: A systematic review. *Evid Based Complement Alternat Med.* 2010;7(4):399-408.
- Kumar V, Jagannathan A, Philip M, Thulasi A, Angadi P, Raghuram N. Role of yoga for patients with type II diabetes mellitus: A systematic review and meta-analysis. *Complement Ther Med.* 2016;25:104-12.
- Malhotra V, Singh S, Tandon OP, Sharma SB. The beneficial effect of yoga in diabetes. *Nepal Med Coll J.* 2005;7(2):145-7.

8. Kahn SE, Hull RL, Utzschneider KM. Mechanisms linking obesity to insulin resistance and type 2 diabetes. *Nature.* 2006;444(7121):840-6.
9. Bird SR, Hawley JA. Update on the effects of physical activity on insulin sensitivity in humans. *BMJ Open Sport Exerc Med.* 2017;2(1):e000143.
10. Gaesser GA, Angadi SS. Obesity treatment: Weight loss versus increasing fitness and physical activity for reducing health risks. *iScience.* 2021;24(10):102995.
11. Mbg movement. 11 Types Of Yoga: A Breakdown Of The Major Styles, 2018. Available at: <https://www.mindbodygreen.com/articles/the-11-major-types-of-yoga-explained-simply>. Accessed on 08 June 2020.
12. Ross A, Thomas S. The health benefits of yoga and exercise: a review of comparison studies. *J Altern Complement Med.* 2010;16(1):3-12.
13. Gutteridge H. *Free radicals in Biology and Medicine.* 5th ed. New York, NY: Oxford University Press; 2007.
14. Kawamura T, Muraoka I. Exercise-Induced Oxidative Stress and the Effects of Antioxidant Intake from a Physiological Viewpoint. *Antioxidants (Basel).* 2018;7(9):119.
15. Cleveland Clinic. Heart Risks Associated With Extreme Exercise, 2018. Available at: <https://health.clevelandclinic.org/cant-too-much-extreme-exercise-damage-your-heart/>. Accessed on 08 June 2020.

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