



Physiological mechanism of yoga exercise as glycemic control in diabetes mellitus patients: a systematic review

Mecanismo fisiológico del ejercicio de yoga como control glucémico en pacientes con diabetes mellitus: una revisión sistemática

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Abstract

Background. This study aims to systematically review how yoga practice affects glycemic control in patients with diabetes mellitus.

Research objectives: This study sought to determine the effects of yoga on glycemic management in individuals with diabetes mellitus.

Methods. Several journal databases were reviewed, including Scopus, Web of Science, Pubmed, and Science Direct. This study considered several variables, including research on yoga, diabetes mellitus, glycemic control, and physical exercise published between 2020 and 2025. Articles that did not meet the inclusion criteria, such as those whose samples were not diabetes mellitus patients, were excluded from this systematic review. Using databases from Scopus, Web of Science, Science Direct, and Pubmed, a total of 727 papers were identified. Ten carefully selected, peer-reviewed studies addressed the need for this systemic change. For this study, a standard operating procedure was established using the Preferred Reporting Systematics and Meta-analysis (PRISMA) guidelines.

Results. The findings of this extensive study demonstrate that regular yoga practice can help people with diabetes mellitus manage their blood sugar levels.

Conclusion. It has been demonstrated that yoga poses help people with diabetes mellitus control their blood sugar levels. Therefore, yoga might be suggested as a treatment for diabetics to manage their blood sugar levels.

Keywords

Yoga exercise; glycemic control; health; diabetes mellitus.

Resumen

Antecedentes. Este estudio tiene como objetivo revisar periódicamente cómo la práctica del yoga afecta el control glucémico en pacientes con diabetes mellitus.

Objetivos de la investigación: Este estudio buscó determinar los efectos del yoga en el manejo de la glucemia en personas con diabetes mellitus.

Métodos. Se revisaron diversas bases de datos de revistas, como Scopus, Web of Science, Pubmed y Science Direct. Este estudio consideró diversas variables, incluyendo investigaciones sobre yoga, diabetes mellitus, control glucémico y ejercicio físico publicadas entre 2020 y 2025. Se excluyeron de esta revisión sistemática los artículos que no cumplían los criterios de inclusión, como aquellos cuyas muestras no incluían pacientes con diabetes mellitus. Utilizando las bases de datos de Scopus, Web of Science, Science Direct y Pubmed, se identificó un total de 727 artículos. Diez estudios cuidadosamente seleccionados y revisados por pares abordaron la necesidad de este cambio sistémico. Para este estudio, se estableció un procedimiento operativo estándar (PRISMA) según las directrices de Sistemática y Metaanálisis de Informes Preferidos (PRISMA).

Resultados. Los resultados de este extenso estudio demuestran que la práctica regular de yoga puede ayudar a las personas con diabetes mellitus a controlar sus niveles de azúcar en sangre.

Conclusión. Se ha demostrado que las posturas de yoga ayudan a las personas con diabetes mellitus a controlar sus niveles de azúcar en sangre. Por lo tanto, el yoga podría recomendarse como tratamiento para la diabetes y así controlar sus niveles de azúcar en sangre.

Palabras clave

Ejercicio de yoga; control glucémico; salud; diabetes mellitus.



Introduction

Diabetes mellitus, commonly known as diabetes, is a dangerous and long-lasting condition characterized by persistently elevated blood glucose levels brought on by either insufficient or malfunctioning insulin production (Hossain et al., 2024). Age, gender and geographical location predispose individuals to diabetes mellitus and make it one of the most common causes of global mortality and morbidity. Both environmental and genetic factors contribute to the etiopathogenesis of type 2 diabetes, which accounts for more than 90% of all cases (The Lancet, 2023). The two most common types of diabetes mellitus, type 1 and type 2, both have diagnostic criteria. The primary cause of type 1 diabetes, which has disastrous consequences for human health, is autoimmune destruction of pancreatic beta cells (Hossain et al., 2024).

A sedentary lifestyle and obesity cause people to develop type 2 diabetes mellitus (The Lancet, 2023). Furthermore, the Global Burden of Disease 2019 study states that heart disease and stroke were the two main causes of disease burden globally in 2019 (Ong et al., 2023). Diabetes is thought to be one of the primary risk factors for both conditions. Insulin resistance is the primary cause of type 2 diabetes mellitus (T2DM), aberrant glucagon production, and pancreatic β -cell dysfunction. Since chronic hyperglycemia causes long-term damage, malfunction, and numerous organ failure, type 2 diabetes is now understood to be a systemic illness (Bodke et al., 2023).

The United States, Bangladesh, Brazil, Italy, Indonesia, Japan, Pakistan, India, and China are the 10 countries with the highest rates of diabetes in the world (Magliano DJ, 2021). As a result, this health problem has become an international emergency. The prevalence of diabetes mellitus is rising far more quickly in low- and middle-income nations than in high-income ones (Ong et al., 2023). By 2030, 643 million people globally are predicted to develop diabetes (Magliano DJ, 2021) with the majority of this increase which has increased by 150% coming from emerging nations (Laraeni et al., 2021). Of course, there must be preventive treatment in reducing the prevalence of diabetes mellitus. In addition, therapeutic efforts are also recommended in inhibiting diabetes mellitus from becoming more severe.

By improving insulin sensitivity and reducing body weight, diabetes risk can be decreased by physical activity. Low-fat individuals are also less likely to develop diabetes. Furthermore, a sedentary lifestyle also slows down the body's secretion system. Because of this, the body will continue to accumulate fat, which will lead to excess weight and the development of diabetes mellitus (Malone & Hansen, 2019). Conversely, appropriate and consistent exercise will enhance muscle function. Physical activity improves blood circulation and lowers blood sugar levels (Sriwahyuni et al., 2021).

Ancient Indian philosophy forms the conceptual basis of yoga. These days, there are numerous schools or varieties of yoga (such as Iyengar, Viniyoga, Sivananda, etc.), and each one focuses differently on a certain percentage of breathing exercises (Pranayama), physical exercises and postures (Asana), deep relaxation, and meditation techniques that increase awareness and lead to deeper states of consciousness (Tiwari & Tirkey, 2024). Yoga incorporates postures, deep breathing and breath control exercises, mental and physical synchronization through repeating verbal expressions, and meditation techniques (mindfulness, focus, awareness, etc.) (Dündar et al., 2024). The goal of yoga, which has its roots in India and dates back over 5,000 years, is to balance and harmonize the emotions, mind, and body. There is mounting evidence that yoga helps manage diabetes and its complications by addressing the pathophysiological underpinnings of the disease (Raveendran et al., 2018). Yoga has several health benefits, such as improved physical fitness, relaxation, and self-awareness. Diabetes and other lifestyle issues can be effectively managed with yoga. Yoga encourages people to exercise and eat more judiciously, which helps them overcome patient-related aversions that lead to underuse of exercise as a therapeutic technique. Yoga helps people maintain a healthy lifestyle and enhance their general quality of life through preventive measures. Yoga therapy has demonstrated less adverse effects and more positive results in adult diabetes patients (Aswathy et al., 2013).

Regular yoga practice regardless of glycemic control, clinical investigations show that it improves cardiac autonomic function and reduces the risk of cardiovascular events (Raveendran et al., 2018). Yoga practice has an impact on blood glucose levels in diabetics. The benefits of yoga should therefore be the main emphasis of methods to encourage individuals to engage in "lifestyle modification practices," such as maximizing adherence to yoga (Angadi et al., 2017). It is unclear exactly how yoga affects glycemic



control in diabetic people. Thus, the function of yoga in controlling glycemic control in individuals with diabetes mellitus will be covered in this systematic study.

Materials and method

Study Design

This study examined and assessed a number of journal databases, such as Scopus, Pubmed, Web of Science, and Science Direct, as part of our systematic review procedure.

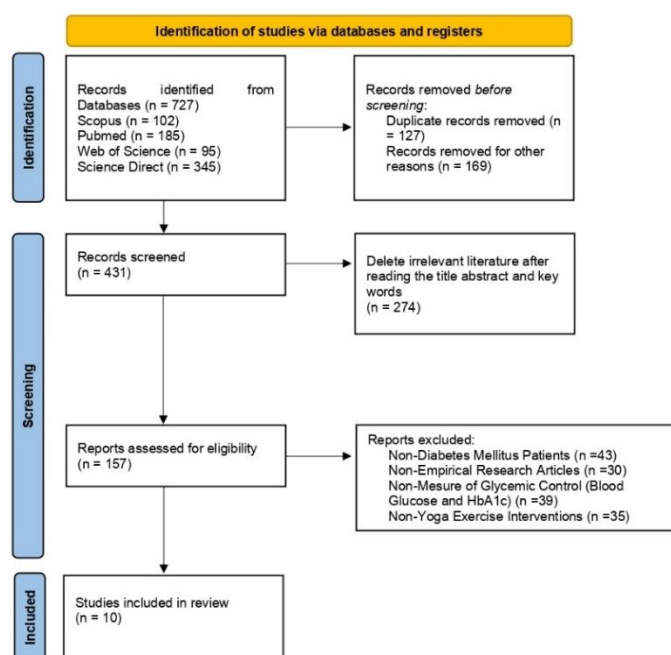
Eligibility Criteria

The inclusion criteria for this analysis were studies on glycemic control in patients with diabetes mellitus and yoga activity published in 2020 - 2025. The exclusion criteria in our review were articles that did not discuss yoga practice and samples that did not suffer from diabetes mellitus were excluded from our review analysis and were not included in our analysis.

Procedure

The Mendeley information database now includes the full texts, abstracts, and titles of articles that have been validated and approved. In the first part of the study, 727 papers were discovered through the databases of Science Direct, Web of Science, Pubmed, and Scopus. The second step involved screening evaluation based on their suitability to the research analysis topic which finally found 431 papers that we analyzed. Then left 157 articles that we further reviewed the next items based on the suitability of the title, abstract, and keywords. We now conducted the analysis according to whether the overall topic was in line with the problem to be addressed or not. In addition, there were several criteria including the studies we analyzed must be experimental studies, the study sample must be humans with diabetes mellitus, and the physical exercise intervention must be yoga. Ten articles that satisfied the inclusion requirements were chosen and reviewed for this systematic review after much deliberation. Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standard operating procedure evaluation, the article selection method's PRISMA flow diagram is displayed in Figure 1.

Figure 1. PRISMA flowchart of the article selection process



Results

Results are presented and analyzed below:

Table 1. Results of Yoga Exercises as Glycemic Control in Diabetes Mellitus Patients

Author	Sample Characteristics	Study Design	Intervention	Results
(Yuniartika et al., 2021)	54 patients with diabetes mellitus were divided into 3 groups: yoga group, walking group, and control group.	Randomized controlled trial	Yoga is done 3x a week for 12 weeks of treatment, the walking group is done every morning between 06.00 - 07.00 with a duration of 30 minutes and is done 3x a week for 12 weeks, the control group is only given standard care through brochures.	Glucose levels decreased significantly after yoga exercise $p<0.05$.
(Sriwahyuni et al., 2023)	Twenty-four individuals with diabetes mellitus were split into two groups at random: the treatment group and the control group.	Randomized controlled trial	The yoga group performed yoga activities + 500 mg metmorphine therapy and the control group only received 500 mg metmorphine.	After practicing yoga, blood sugar levels significantly decreased $p<0.05$.
(Lavanya & Devi, 2021)	30 women with diabetes mellitus underwent a pretest and posttest study.	Randomized controlled trial	Yoga exercises are done every morning for 30 minutes.	Following the yoga intervention, blood glucose levels significantly decreased $p<0.05$.
(Hirosaki et al., 2023)	42 individuals with diabetes mellitus were split into two groups: the control group and the yoga intervention group.	Randomized controlled trial	The yoga practice was 60 minutes per session and was carried out for 12 weeks.	Following the intervention, the HbA1c levels significantly decreased $p<0.05$.
(Ranga et al., 2021)	In this study, 100 patients with diabetes mellitus were split into two groups: the treatment group and the control group.	Randomized controlled trial	Patients did yoga for 3 months, the training was guided by yoga practitioners. The control group did not do yoga.	Following the intervention, the HbA1c levels significantly decreased $p<0.05$.
(Gowri et al., 2022)	In this study, 70 individuals with diabetes mellitus were split into two groups: the treatment group and the control group.	Randomized controlled trial	Yoga therapy is done 10 teaching sessions. 2x a week and done for 120 days at home.	There was a significant decrease in HbA1c levels after 120 days of intervention $p<0.05$.
(Kaur et al., 2021)	184 patients with diabetes mellitus participated in this study and were divided into 2 groups: control group and treatment group.	Randomized controlled trial	Yoga practice was done 60 minutes per session for 3 months.	There was a significant reduction in post-meal glucose levels after 3 months of intervention $p<0.05$.
(Saberipour et al., 2020)	In this study, 108 patients with diabetes mellitus were split up into three groups: the control group, the yoga group, and the walking group.	Randomized controlled trial	Yoga exercises were done 60 minutes per session, 3 sessions per week for 8 weeks and walking exercises were also done for 8 weeks.	Fasting blood glucose levels dropped considerably ($p<0.05$) after the yoga intervention.
(Balaji et al., 2020)	In this study, 72 individuals with diabetes mellitus were split into two groups: the control group and the yoga group.	Randomized controlled trial	Yoga exercises were performed 60 minutes per session for 4 months of treatment.	Following the yoga session, fasting blood glucose levels significantly decreased ($p<0.05$).
(Sharma et al., 2020)	In this study, 104 patients with diabetes mellitus were split into two groups: the control group and the yoga group.	Randomized controlled trial	Yoga exercises were performed 40 minutes per session 5x a week for 6 months of treatment.	Fasting blood glucose levels dropped considerably ($p<0.05$) after the yoga intervention.

Discussion

This study analysis's goal is to determine how yoga affects glycemic control in patients with diabetes mellitus. Research results from Yuniartika et al., 2021 proved that yoga exercises done 3x a week for 12



weeks have a real impact on lowering blood glucose levels in people with diabetes $p < 0.05$. In addition, this study also proved that walking also has a significant impact on lowering blood glucose. Both activities have a positive effect on glycemic control in people with diabetes mellitus. The results of another study conducted by Sriwahyuni et al., 2023 also proved a significant reduction in blood sugar levels after yoga intervention in patients with diabetes mellitus $p < 0.05$. Another study conducted by Lavanya & Devi, 2021 that practicing yoga for 30 minutes every morning also had a significant impact on lowering blood sugar levels in individuals with diabetes $p < 0.05$. So it has been known that yoga is indeed effective as a therapeutic effort in diabetes mellitus patients to reduce the adverse effects caused by the disease.

Hirosaki et al., 2023 also conducted research on 42 patients with diabetes mellitus who had been divided into 2 groups, namely the yoga treatment group and the control group, the intervention was carried out 60 minutes for 12 weeks which proved that there was a significant decrease in HbA1c levels significantly after the intervention $p < 0.05$. Another study also proved the same thing that patients who had been given yoga intervention for 3 months proved a significant decrease in HbA1c levels after the intervention $p < 0.05$ (Ranga et al., 2021). Other data shows that yoga therapy performed 2x a week for 120 days in patients with diabetes mellitus is proven to significantly reduce HbA1c levels $p < 0.05$ (Gowri et al., 2022). There is no specific explanation of which duration and intensity are effective in lowering HbA1c. However, in our systematic review we stated that based on the literature it shows that chronic yoga practice has a significant impact on lowering HbA1c. This means that the exercise is not done only once but there is a certain period starting from 3 months to 6 months more than the literature that proves a statistically significant impact. However, to provide a definite explanation, of course, it is necessary to conduct a direct experimental study of yoga practice in a certain period or can be called chronic exercise on HbA1c.

Mechanism of Yoga Exercise as Glycemic Control in Diabetes Mellitus Patients

A three-month yoga intervention has been shown in prior research to dramatically improve glycemic control, lower insulin needs, and enhance quality of life in adolescents with type 1 diabetes (Maurya et al., 2025). The results of this study align with prior research demonstrating the advantages of yoga in diabetes treatment across diverse age demographics (Kaur et al., 2021). The results of this study are consistent with earlier studies that demonstrated the advantages of yoga for managing diabetes in a range of age groups (Maurya et al., 2025). It has been demonstrated that some yoga poses, including Ardha Matsyendra Asana, Bhujang Asana, and Dhanurasana, enhance pancreatic function and increase insulin production (Jahandarpour & Sobhani, 2022). Sun salutation, or surya namaskara, is a sequence of postures done in a certain order. This raises the need for oxygen and glucose in the cells, which in turn promotes the synthesis of insulin (S Mullur & Ames, 2016).

The advantages of yoga for diabetes are influenced by immunological and psychoneuroendocrine processes because diabetes is a psychosomatic illness that affects both the body and the psyche (Raveendran et al., 2018). Charaka, the founder of the ancient Indian medical system known as Ayurveda, was the first to propose the concept of positive health. He wrote the "Charaka Samhita," which is considered the founding literature of Ayurveda. Charaka compares the body, mind, and soul to a tripod (Dwivedi & Singla, 2014). Two categories of illnesses are mentioned in the Vasistha Samhita. One is physical, while the other is mental (Dhali et al., 2023). Both physical and mental manifestations of illness are possible. In contrast to somatopsychic disorders, which originate in the body, psychosomatic illnesses appear in the mind. Yoga is a form of therapy that treats the mind and body (Satish, 2013). The Vedic philosophy of yoga holds that the human body is a synthesis of the mind, body, and soul (Dhali et al., 2023).

It has been demonstrated that yoga greatly lowers blood sugar levels in diabetics. Yoga and similar programs teach participants to induce a relaxation response using a variety of postures, meditation, and regulated breathing techniques (Gowri et al., 2022). This reaction can lead to an upregulation of cortisol and other stress hormones that normally elevate blood pressure and blood sugar levels. There is sufficient data to conclude that insulin resistance is a risk factor for the onset of cardiovascular disease and plays a major pathophysiologic function in diabetes mellitus (Dündar et al., 2024). Previous research has demonstrated the benefits of both physical activity and incorporated yoga practices (Chimkode et al., 2015).



Another intervention technique to enhance glycemic control which is currently advised to lessen diabetes mellitus and insulin resistance is a planned yoga treatment regimen. Among individuals with diabetes mellitus who have peripheral neuropathy, Insulin resistance, visceral fat, fasting blood sugar, and musculoskeletal mass are all associated with BMI (Sampath Kumar et al., 2019). The fact that oxidative stress is a primary issue with metabolic syndrome is another significant factor. By altering several facets of insulin receptor signal transduction, oxidative stress results in insulin resistance in peripheral tissues (Gowri et al., 2022). As a result, the GLUT4 transporter's expression in the cell membrane declines (Gowri et al., 2022). Additionally, we think that by lowering oxidative stress, several yoga therapies may directly aid in the renewal of pancreatic cells. This could result in better glucose metabolism and use in the liver, adipose tissue, and peripheral tissues (Ismail et al., 2014). Exercise is also the best way to lessen the negative consequences that people with diabetes mellitus experience. Exercise enhances the GLUT4 translocation mechanism, which facilitates glucose uptake, according to earlier research (Ayubi et al., 2024). Skeletal muscle glucose uptake can be efficiently increased by exercise (Sampath Kumar et al., 2019). By enhancing blood glucose uptake, GLUT4 offers a biological signaling pathway that is activated by insulin to reduce blood glucose levels (Cho & Shaw, 2024).

Research result by Kaur et al., 2021 demonstrated that a three-month yoga intervention lasting 60 minutes each session resulted in a significant drop in blood glucose levels. Other research results conducted by Saberipour et al., 2020 demonstrated that practicing yoga for 60 minutes three times a week for eight weeks resulted in a drop in blood glucose levels. Yoga exercises performed 60 minutes per session for up to 4 months of treatment proved a significant reduction in blood glucose levels (Balaji et al., 2020). So it can be emphasized that yoga is a recommendation for therapeutic efforts in patients with diabetes mellitus in an effort to reduce the adverse effects it causes through lowering blood glucose levels. Finally, this statement is also corroborated by the results of research by Sharma et al., 2020 that 40 minutes of yoga practice per session 5x a week for 6 months proved that there was a significant decrease in blood glucose levels in patients with diabetes mellitus. For people with diabetes mellitus, it is highly recommended to do yoga as a preventive and therapeutic effort in reducing the adverse effects caused by diabetes mellitus.

It is well known that yoga provides extraordinary benefits, especially for people with diabetes mellitus. This study has proven that yoga is effective in controlling blood glucose. Physical activity is the best non-pharmacological therapy in an effort to improve health. However, yoga can be an alternative therapy in maintaining and controlling blood sugar levels, especially for people with diabetes mellitus. The limitation of our study is that we only analyzed literature that showed that yoga practice has a significant impact on reducing HbA1c. However, from the literature we analyzed, some had small samples, so this is a limitation of our study. Therefore, to find out for sure and in depth, further research and experiments are needed to prove how yoga practice affects reducing HbA1c.

Strenght and Limitations

This systematic review has the advantage of focusing just on randomized controlled trials, the most trustworthy form of scientific evidence and removing the potential for ambiguous causal links. Additionally, the samples that were gathered were limited to people with diabetes mellitus and included consistent data; they were not mixed with samples from other groups, such as animals or healthy people without the disease.

We discovered that there was a dearth of information about the benefits of physical activity, particularly yoga, for lowering blood sugar levels and improving glycemic control. As a result, it is thought that this study is crucial to carry out in order to gain more understanding and information about how yoga exercise might assist regulate blood sugar. One suggestion for the population, particularly for those with diabetes mellitus, is yoga activity. To find out what duration and intensity are more effective in lowering blood glucose and aiding in glycemic control in patients with diabetes mellitus, more experimental research is required. This is because there are a number of factors that may be related to the duration and effective intensity that are not yet known for sure. This may serve as a guideline for treatment aimed at assisting those with diabetes mellitus in lessening the negative consequences of the condition.

Conclusions

Yoga exercises have been proven to be able to control glycemic levels in patients with diabetes mellitus significantly. However, to prove it, clinical research is needed on the impact of yoga exercises on glyce-mic control in patients with diabetes mellitus. Therefore, experimental research is recommended to prove it.

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