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Review Article

Diabetes Mellitus

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Diabetes Mellitus prevention and management with Yoga

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Diabetes mellitus (DM), a chronic metabolic disorder characterized by hyperglycemia, has become a global health concern. Lifestyle modifications, including physical activity and stress management, play a crucial role in its prevention and management. Yoga, an ancient mind-body practice, has gained recognition as a complementary approach to conventional diabetes care. This abstract explores the potential of yoga in preventing and managing diabetes by addressing its multifactorial causes. Yoga combines physical postures (asanas), breathing techniques (pranayama), and meditation (dhyana), which collectively improve insulin sensitivity, reduce blood glucose levels, and enhance overall metabolic health. Regular practice of yoga has been shown to lower fasting and postprandial blood glucose levels, improve lipid profiles, and reduce oxidative stress, all of which are critical in diabetes management. Additionally, yoga promotes weight loss and reduces visceral fat, key factors in preventing type 2 diabetes. Stress is a significant contributor to diabetes, as it triggers the release of counter-regulatory hormones like cortisol, which elevate blood glucose levels. Yoga's emphasis on relaxation and mindfulness helps reduce stress, thereby improving glycemic control. Furthermore, yoga enhances cardiovascular health, reduces inflammation, and improves autonomic nervous system function, all of which are beneficial for individuals with diabetes.

Keywords: Diabetes mellitus, Lifestyle, Diet, Yoga, Pranayama

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Introduction

Diabetes mellitus (DM) is a metabolic disease, involving inappropriately elevated blood glucose levels. DM has several categories, including type 1, type 2, maturity-onset diabetes of the young (MODY), gestational diabetes, neonatal diabetes, and secondary causes due to endocrinopathies, steroid use, etc.

The main subtypes of DM are Type 1 diabetes mellitus (T1DM) and Type 2 diabetes mellitus (T2DM), which classically result from defective insulin secretion (T1DM) and/or action (T2DM).

T1DM presents in children or adolescents, while T2DM is thought to affect middle-aged and older adults who have prolonged hyperglycemia due to poor lifestyle and dietary choices. The pathogenesis for T1DM and T2DM is drastically different, and therefore each type has various etiologies, presentations, and treatments.

Etiology

In the pancreas, there are two main subclasses of endocrine cells: insulin-producing beta cells and glucagon secreting alpha cells. Beta and alpha cells are continually changing their levels of hormone secretions based on the glucose environment. Without the balance between insulin and glucagon, the glucose levels become inappropriately skewed. In the case of DM, insulin is either absent and/or has impaired action (insulin resistance), and thus leads to hyperglycemia.

T1DM is characterized by the destruction of beta cells in the pancreas, typically secondaryto an autoimmune process. The result is the absolute destruction of beta cells, and consequentially, insulin is absent or extremely low.

T2DM involves a more insidious onset where an imbalance between insulin levels and insulin sensitivity causes a functional deficit of insulin. Insulin resistance is multifactorial but commonly develops from obesity and aging.

T2DM involves a more complex interplay between genetics and lifestyle. There is clear evidence suggesting that T2DM is has a stronger hereditary profile as compared to T1DM. The majority of patients with the disease have at least one parent with T2DM.

Epidemiology

- According to study,11.4%of the population in India has diabetes.This is equivalent to over 100 million people.
- The study also found that 15.3% of the population in India has pre-diabetes.
- The study involved 113,000 participants over the age of 20 from every state in India.
- The study found that diabetes was more prevalent in urban areas than rural areas.
- The study also found that the highest prevalence of diabetes was in Goa, Puducherry, and Kerala.

Globally, 1 in 11 adults has DM (90% having T2DM). The onset of T1DM gradually increases from birth and peaks at ages 4to 6 years and then again from 10to 14 years.Approximately 45% of children present before age ten years. The prevalence in people under age 20 is about 2.3per 1000. While most autoimmune diseases are more common in females, there are no apparent gender differences in the incidence of childhood T1DM. In some populations, such as in older males of European origin (over 13 years), they may be more likely to develop T1DM compared to females (3:2 male to female ratio).The incidence of T1DM has been increasing worldwide.

The onset of T2DM is usually later in life, though obesity in adolescents has led to an increase in T2DM in younger populations. Experts expect the prevalence of DM to increase from 415 to 642 million by 2040, with the most significant increase in populations transitioning from low to middle-income levels.

Pathophysiology

A patient with DM has the potential for hyperglycemia. The pathology of DM can be unclear since several factors can often contribute to the disease. Hyperglycemia alone can impair pancreatic beta-cell function and contributes to impaired insulin secretion.

Consequentially, there is a vicious cycle of hyperglycemia leading to an impaired metabolic state. Blood glucose levels above 180 mg/dL are often considered hyperglycemic in this context, though because of the variety of mechanisms, there is no clear cutoff point.

Patients experience osmotic diuresis due to saturation of the glucose transporters in the nephron at higher blood glucose levels. Although the effect is variable, serum glucose levels above 250 mg/dL are likely to cause symptoms of polyuria and polydipsia.

***Madhumeha*[1]**

Ayurvedic remedies for *Madhumeha* (diabetes mellitus) are the oldest and are classified as *Prameha*. *Pramehas* are a group of urinary illnesses characterised by excessive urination and many aberrant features caused by *Doshic* imbalances. *Prameha* is caused primarily by a lack of exercise and poor dietary habits.

The basic causes of this ailment include excessive food intake in the categories of *Ushna*, *Snigdha*, and *Guru*-fish and curd are good examples. The etiological causes for *Prameha* are foods that enhance *Kapha*, *Medhas*, and *Moothra*. *Prameha* is derived from the words *Pra*(overflow) and *Meha* (*Ksharane*) (urine passing). *Prameha* is passing turbid urine as a result (*Prabhootha Avila Mootrata*).

Causes

Lack of exercise, excessive sleep, excess use of milk, use of newly harvested cereals, laziness, sedentary habits, consumes food and drink which are cold.

Classification[2,3]

1. Prameha is classified aetiologically in *Sahaja* (defect in sperm or ovum or both at the level of chromosome or gene) and *Apathya Nimittaja* (Unwholesome things-food and exercise etc.)
2. On the basis of body constitution

- *Sthoola* (obese)
- *Krisha* (Emaciated)

3. On the basis of dominant *Dosha*

- *Kaphaja* - ten types
- *Pittaja* - six types
- *Vataja* - four types

Out of these, diabetes mellitus is termed as *Madhumeha* It is one of the four *Vataja Pramehas*.

***Samprapti Ghatakas*[4]**

Dosha - Kapha predominant *Tridosha*
Dushya - Meda predominant along with *Rasa*, *Asrik*, *Mansa*, *Majja*, *Vasa*, *Shukra*, *Oja*, *Lasika*, *Kleda* & *Sweda*.
Srotasa - Medovaha, *Mutravaha*, *Udakavaha*
Srortodushti - Atipravritti
Agni - Vaishamya of all *Agni* (*Dhatwagnimandya*)
Adhishthana - Vasti, *Sarva Sharir*
Udbhavasthana - Amashaya
Ama - Medogata
Sanchara - Rasayani

Some Yoga practices beneficial for the management and prevention of Diabetes Mellitus.

Yoga technique	Approximate duration and remarks
Cleansing practices:Shuddhi Kriya	
Kapalbhati(frontal brain purification)	5 rounds, 120 strokes
Agnisar Kriya(stimulating the digestive fire)	5 rounds
Vaman Dhauti(stomach cleansing)	Once a week
Full Shankhaprakshalana(intestine cleansing)	Once a year
Laghu Shankhaprakshalana(short cleansing)	Every 40 days
Preparatory practices/warming up	5–10 minutes
Surya Namaskar	Slow speed, 3–7 rounds according to an individual's capacity
Yoga postures:Asanas	
Standing postures	
Trikonasan(triangle pose)	Recommended to hold the final pose for 15 seconds, gradually increasing the duration up to 1 minute
Tadasan(palm tree pose)	
Tiryak Tadasan(bent palm tree pose)	
Veerasan(warrior pose)	
Seated poses	
Vakrasan(spinal twist)	Recommended to hold the final pose for 15 seconds, gradually increasing the duration up to 1 minute
Ardhamatsyendrasan(seated spinal twist)	
Mandukasan(frog pose)	
Ushtrasan(camel pose)	

Paschimottanasan(seated forward bend)	
Yoga mudra(forward bend)	
Prone poses	
Bhujangasan(cobra pose)	Recommended to hold the final pose for 15 seconds, gradually increasing the duration up to 1 minute
Dhanurasan(bow pose)	
Naukasan(boat pose)	
Makarasan(crocodile pose)	Relaxation pose: 2–5 minutes as needed
Supine poses	
Pavanmuktasan(wind releasing pose)	Recommended to hold the final pose for 15 seconds, gradually increasing the duration up to 1 minute
Supta vajrasana(supine thunderbolt pose)	
Setubandhasan(bridge pose)	
Matsyasan(fish pose)	
Shavasan(corpse pose)	Relaxation pose: 2–5 minutes as needed
Inversions	
Sarvangasan(shoulder stand)	Hold the final pose for 15 seconds, gradually increasing the duration up to 1 minute
Halasan(plough pose)	
Regulated breathing practices:pranayama	
Anulom Vilom(alternate nostril breathing)	5–10 minutes
Chandra Bhedan(left nostril breathing)	5 minutes
Surya Bhedan(right nostril breathing)	5 minutes
Bhastrika(bellows breath)	3–5 minutes
Bhramari(humming bee breath)	5 rounds
Sheetali/Sitkari(cooling breath)	3–5 minutes
Lock:Bandha	
Uddiyan bandha(abdominal lock)	5 rounds
Hand gestures:Mudras	
Linga Mudra,Surya Mudra,Prana Mudra,Apan Mudra,Gyan Mudra	15–45 minutes
Meditation	10 minutes or more
Meditation onManipur Chakra(solar plexus)	10 minutes
"Aum" chanting	5 minutes
Yogic relaxation:Yoga Nidra	30 minutes

Some of the beneficial effects of Yoga practices in Diabetes Mellitus.

Yoga practice	Effects
Surya Namaskarsun salutation	Stimulates insulin production through brain signalling.[5]
A series of dynamic yoga postures in a specific sequence	Significantly decreases hip circumference, exerting beneficial effects on glycaemic outcomes.[6]
Yoga Asana(yoga postures)	Rejuvenates of pancreatic cells through the alternating abdominal contractions and relaxations involved in yoga practice Improves blood supply to muscles Enhances insulin receptor expression in the muscles, causing increased glucose uptake by muscles Has positive effects on glucose utilization and fat redistribution in type 2 diabetes
Forward bend	Massages and pressurizes the pancreas, stimulating insulin secretion
Backward bend	Exerts stimulating and energizing effects
Twisted poses	Squeeze the intestines to prevent stagnation of colonic contents
Inversions	Improve blood circulation
Shuddhi Kriyacleansing processes	
Kapalbhati(frontal brain purification): breathing technique with forceful exhalations and automatic inhalations	Abdominal pressure created during exhalation improves the efficiency of β-cells of the pancreas Helps in the production of insulin and controlling glucose levels in the blood

Agnisar Kriya(stimulating the digestive fire): pulling the abdomen in (Uddiyan Bandha) and snapping it backwards and forwards while holding one's breath	The 'vacuum' effect of this action massages the internal organs and increase blood flow to the area Boosts metabolism and facilitates proper functioning of the abdominal organs.[7]
Vaman Dhauti(stomach cleansing with induced vomiting)	Increases glucose uptake, minimizes insulin resistance, and promotes the function of insulin by reducing levels of circulating free fatty acids in the body Marked reduction in fasting and post-prandial blood sugar levels
Shankhaprakshalana(intestine cleansing)	Significantly reduces blood glucose levels Increases insulin production[5]
Pranayama(regulated breathing)	
SlowPranayama,Anulom Vilom,Chandrabhedan,Sitkari, andBhramari	Augment cerebral blood flow and oxygenation, improving neuronal activities in the brain centres, including those present in the limbic areas, hypothalamus, and medulla, and improve sympathovagal outflow.[8]
Anulom Vilom(alternate nostril breathing)	Improves components of health-related fitness, i.e., cardiorespiratory endurance, flexibility, and body fat percentage.[9]
Bhramari(humming bee breath)	Soothing and calming effect on the mind, improves mental and physical health.[10]
Sheetali/Sitkari(cooling breath)	Lowers blood pressure, cooling effect
Chandra Bhedan(left nostril breathing)	Parasympathetic stimulation
Surya Bhedan(right nostril breathing)	Sympathetic stimulating effect; may be recommended in people with diabetes.[11]
Bhastrika(bellows breath)	Regulation of pineal, pituitary, and adrenaline glands, important role in the regulation of metabolism.[12]
Bandha(lock)	
Constricts a certain part of the body	Re-directs the flow of blood and lymph to other body parts
Uddiyan bandha(abdominal lock): creation of negative pressure in abdomen and contraction of abdomen	Negative pressure created in the abdominal cavity may improve pancreatic function
Hasta Mudras(hand gestures)	
Apan Mudra,Gyan Mudra	Promote deep relaxation and eliminate stress
Linga Mudra,Surya Mudra,Prana Mudra	Boost metabolic rates, promote weight loss, and reduce sugar levels
Dhyan(meditation)	Beneficial psychological effects, such as faster reactions to stimuli and being less prone to various forms of stress,[13] anxiety reduction, and blood pressure control.[14]
Meditation on the ManipurChakra(solar plexus), visualization of pancreas during meditation	Positive effects on sugar levels
Mindfulness	Better sleep, greater relaxation, more accepting approaches to illness and the illness experience in people with diabetes and coronary heart disease.[15]
"Aum" chanting	Stabilizes the brain, removes negative thoughts, increases energy, improves mind and body relaxation within minutes of practice.[16] Chanting in the supine posture produces an integrated relaxation response.[17]
Yoga Nidra(yogic relaxation)	Improved symptom score, reduction of fasting blood glucose and postprandial blood glucose levels

Discussion

Diabetes mellitus (DM), a chronic metabolic disorder, can be effectively prevented and managed through yoga, a holistic practice combining physical postures, breathing exercises, and meditation. Yoga aids in diabetes prevention by promoting weight management, reducing stress, and improving insulin sensitivity. For individuals with prediabetes or at risk of T2DM, yoga encourages healthy lifestyle habits and enhances metabolic function. In diabetes management, yoga complements conventional treatments by improving blood glucose control, reducing HbA1c levels, and enhancing cardiovascular health.

Specific asanas like *Paschimottanasana* (Seated Forward Bend) and *Ardha Matsyendrasana* (Half Spinal Twist) stimulate the pancreas, potentially boosting insulin production. *Pranayama* (breathing exercises) and meditation reduce stress, a key contributor to insulin resistance, while also addressing mental health challenges like depression and anxiety. Research supports yoga's role in diabetes care, with studies showing improved glycemic control, lipid profiles, and overall well-being. However, *Yoga* should not replace standard treatments but rather be integrated into a comprehensive care plan. Individuals with complications should consult healthcare providers before starting *Yoga*.

Conclusion

Yoga can be a valuable complementary approach in the prevention and management of diabetes mellitus. Regular practice of yoga has been shown to improve insulin sensitivity, reduce blood glucose levels, lower stress, and promote overall physical and mental well-being. Specific *Asanas* (postures), *Pranayama* (breathing exercises), and meditation techniques help regulate metabolic functions, enhance circulation, and reduce stress-related hormonal imbalances, which are critical factors in diabetes prevention.

While *Yoga* alone may not entirely prevent diabetes, it can significantly contribute to a healthier lifestyle when combined with a balanced diet, regular physical activity, and medical guidance. Its holistic approach addresses not only the physical but also the emotional and psychological aspects of health, making it a sustainable practice for long-term diabetes prevention and overall wellness.

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