



**Review Article**

**A YOGA BASED APPROACH FOR PRIMARY LEVEL PREVENTION OF LIFESTYLE - INDUCED TYPE 2 DIABETES MELLITUS**

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**ABSTRACT**

Type 2 Diabetes Mellitus (T2DM) is a global metabolic disorder characterized by insulin resistance, impaired pancreatic  $\beta$ -cell function, and progressive dysregulation of glucose metabolism, contributing substantially to long-term morbidity and premature mortality. Its escalating prevalence- driven primarily by sedentary lifestyles, unhealthy dietary patterns, obesity, and chronic stress- underscores the need for preventive strategies that extend beyond pharmacotherapy. Yoga, a holistic, accessible, and cost-effective practice, has emerged as a promising non-pharmacological intervention for the primary prevention of T2DM. Evidence suggests that selected *Yogasanas*, *Pranayama* techniques, and *Kriyas* modulate key pathophysiological mechanisms of T2DM by enhancing insulin sensitivity, stimulating  $\beta$ -cell activity, improving hepatic and digestive function, and optimizing autonomic balance. Postures such as *Tadasana*, *Paschimottanasana*, *Ushtrasana*, *Halasana*, and specific twisting and inversion poses may facilitate peripheral glucose uptake, enhance organ perfusion, strengthen musculoskeletal integrity, and support metabolic efficiency. Pranayama practices including *Bhastrika*, *Chandra Bhedana*, and *Kapalabhāti* have been shown to attenuate sympathetic overactivity, reduce cortisol levels, and promote parasympathetic dominance, thereby mitigating stress-induced hyperglycaemia. From an Ayurvedic perspective, yoga addresses the etiopathogenesis of *Sthoola Prameha* by correcting *Agnimandya*, reducing excess *Kapha* and *Meda*, and preventing *Srotorodha*, thereby restoring metabolic homeostasis. Given its safety profile, affordability, and adaptability for community-level implementation, yoga represents an effective multidimensional strategy for reducing modifiable risk factors- particularly sedentary behaviour, central adiposity, and psychosocial stress- thereby supporting T2DM prevention and broader health promotion.

**INTRODUCTION**

Type 2 Diabetes Mellitus (T2DM) has emerged as one of the most significant non-communicable diseases of the 21<sup>st</sup> century, contributing significantly to global morbidity, mortality, and healthcare expenditure. The global burden of diabetes has escalated dramatically, rising from approximately 200 million people in 1990 to nearly 830 million in 2022, with the most rapid increases observed in low- and

middle-income countries. Alarming, in 2022 more than half of individuals living with diabetes were not receiving appropriate pharmacological treatment, particularly in resource-constrained settings. Diabetes is a leading cause of blindness, kidney failure, cardiovascular disease, stroke, and limb amputation. In 2021, diabetes and diabetic kidney disease caused over 2 million deaths, while high blood glucose accounted for about 11% of all cardiovascular mortality<sup>[1]</sup>. The prevalence of T2DM has increased substantially over the past three decades, driven largely by rapid urbanization, increasingly sedentary lifestyles, dietary transitions towards calorie-dense processed foods, rising obesity rates, and chronic stress. These predominantly lifestyle-related determinants make the condition particularly amenable to prevention through

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targeted behavioural and environmental interventions. Consequently, contemporary public health frameworks emphasize primary prevention, prioritizing early risk reduction among healthy individuals and those exhibiting prediabetic tendencies.

In recent decades, yoga has gained considerable recognition as a holistic, cost-effective, and culturally adaptable health-promoting practice. Regular performance of *Yogasanas* has been shown to enhance musculoskeletal strength, improve metabolic efficiency, reduce central adiposity, and modulate neuroendocrine regulation. Emerging evidence suggests that yoga can improve insulin sensitivity, reduce sympathetic overactivity, enhance pancreatic function, and support psychological wellbeing- each of which plays a pivotal role in interrupting the pathophysiological progression towards T2DM. The selection of appropriate *Yogasanas* for primary prevention necessitates an understanding of their physiological mechanisms, accessibility, and safety for the general population. Furthermore, the integration of pranayama (yogic breathing) and relaxation techniques may attenuate stress-mediated pathways implicated in metabolic dysfunction, thereby strengthening the preventive potential of yoga-based interventions.

This article examines simple *Yogasanas*, selected breathing practices, and specific kriyas that can help reduce the risk of Type 2 Diabetes Mellitus. It outlines the physiological mechanisms underlying these practices by integrating evidence from modern scientific research with foundational yogic principles and highlights how they can be feasibly implemented at the community level. By emphasizing yoga as a strategy for primary prevention, the article advocates a non-pharmacological approach to mitigating the growing burden of T2DM.

### **Etiology**

Diabetes mellitus, commonly referred to as diabetes, is a major metabolic and endocrine disorder characterized by persistently elevated blood glucose levels. It occurs either due to inadequate insulin secretion by the pancreatic  $\beta$ -cells or because peripheral tissues become resistant to insulin, resulting in impaired cellular glucose uptake. Insulin, secreted by the  $\beta$ -cells of the pancreas, facilitates the entry of glucose into cells and is essential for maintaining blood glucose concentrations within physiological limits. When insulin production is insufficient or cellular responsiveness is diminished, glucose uptake is compromised, leading to

disturbances in carbohydrate, fat, and protein metabolism.<sup>[2]</sup>

The etiology of diabetes mellitus is multifactorial and varies according to the specific type of the disorder.

Type 1 diabetes is primarily caused by autoimmune destruction of pancreatic  $\beta$ -cells, typically influenced by genetic susceptibility and environmental triggers such as viral infections.

Type 2 diabetes, the most prevalent form, develops due to the combined effects of insulin resistance and relative insulin deficiency, and is strongly associated with lifestyle-related factors- particularly obesity, physical inactivity, and unhealthy dietary patterns, as well as genetic predisposition.

Gestational diabetes occurs during pregnancy due to hormonal changes that impair glucose tolerance and reduce insulin sensitivity, leading to hyperglycaemia.

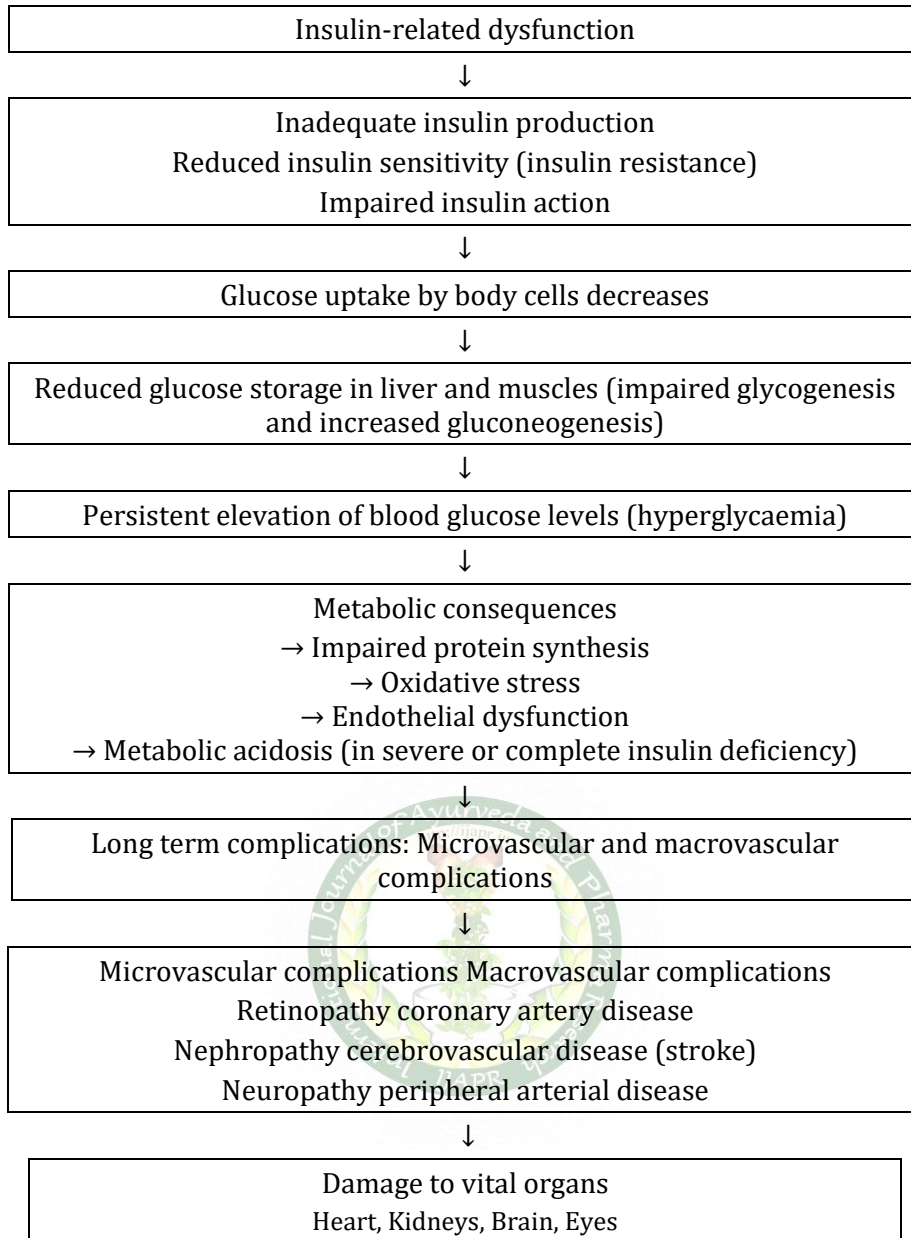
Other rare forms of diabetes arise from genetic defects, pancreatic disorders, endocrine abnormalities, or other identifiable medical conditions.

### **Types<sup>[3]</sup>**

According to the World Health Organization (WHO), diabetes mellitus is categorized into six major types:

1. **Type 1 diabetes**  
Autoimmune destruction of pancreatic  $\beta$ -cells leading to absolute insulin deficiency.
2. **Type 2 diabetes**  
Characterized by insulin resistance and relative insulin deficiency, commonly associated with lifestyle factors and genetic predisposition.
3. **Hybrid forms of diabetes**  
Includes conditions that demonstrate features of both Type 1 and Type 2 diabetes, such as slowly progressing immune-mediated diabetes in adults and ketosis-prone Type 2 diabetes.
4. **Hyperglycaemia first detected in pregnancy (Gestational diabetes)**  
Reduced insulin sensitivity and impaired glucose tolerance due to pregnancy-related hormonal changes.
5. **Other specific types of diabetes**  
Secondary to identifiable causes such as genetic defects, pancreatic disorders, endocrine pathologies, or drug-induced hyperglycaemia.
6. **Unclassified diabetes**  
Cases in which the clinical characteristics do not clearly fit into existing categories, and further evaluation is required to determine the underlying mechanism.

**Pathophysiology of Type 2 Diabetes Mellitus**



**Clinical Manifestations of Type 2 Diabetes Mellitus**

- Polyuria (increased urination)
- Polydipsia (excessive thirst)
- Polyphagia (increased appetite)
- Unintended weight loss
- Blurred vision
- Persistent fatigue
- Irritability and mood swings

**Diagnosis<sup>[2]</sup>**

Diagnosis of Type 2 Diabetes Mellitus is based on biochemical criteria as per standard guidelines:

Test / Parameter	Diagnostic Cut-off Value
HbA1c	≥ 6.5%
Fasting Plasma Glucose (FPG)	≥ 126 mg/dL (7.0 mmol/L)
2-hour Plasma Glucose (OGTT)	≥ 200 mg/dL (11.1 mmol/L)
Random Plasma Glucose	≥ 200 mg/dL (11.1 mmol/L)

**Prameha**

*Prameha*, owing to its severity and chronic nature, is regarded as a *Mahagada* (grave disease) in Ayurveda. It is defined as “*Prakarshena adhikyena mehati iti*”, referring to the excessive and frequent passage of turbid urine. The term *Prameha* is derived from “*Pra*” (overflow) and “*Meha*” (*Ksharana* or urination), indicating a condition characterized by *Prabhuta Avila Mutrata*- large quantities of cloudy or turbid urine.<sup>[4]</sup>

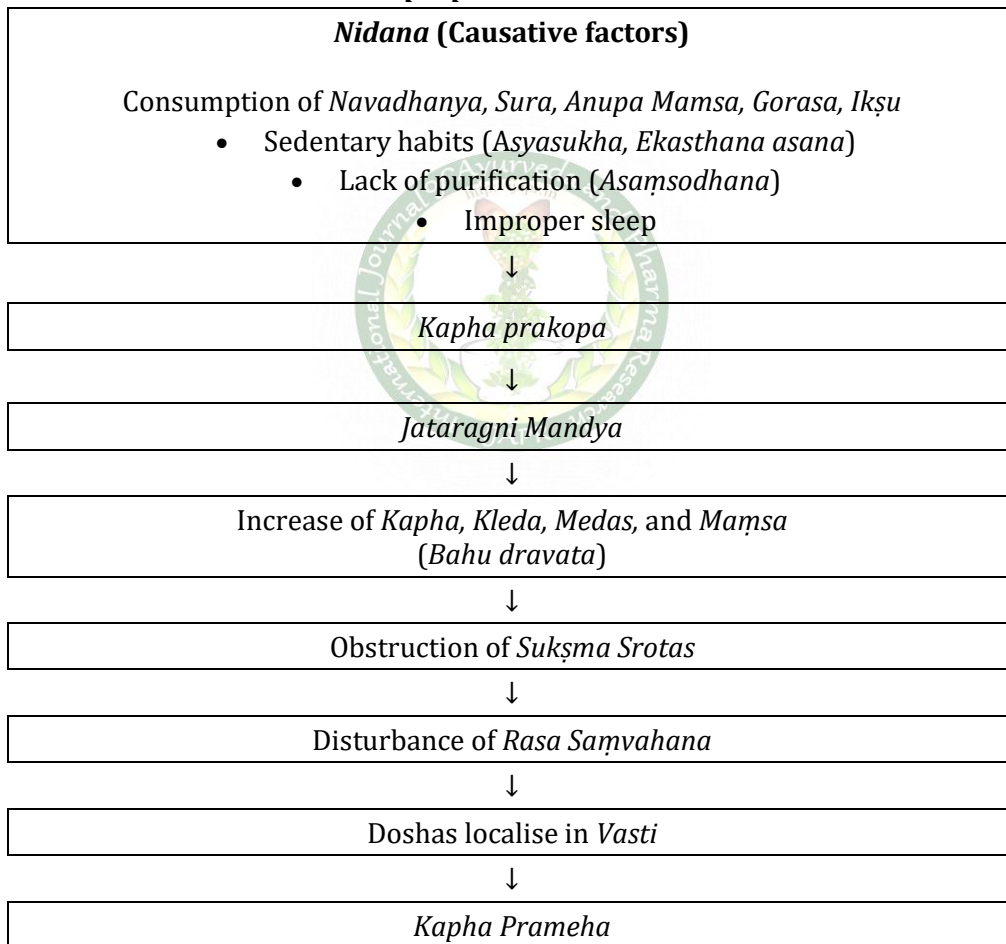
**Etiology**

*Prameha* may arise from several lifestyle and dietary factors that increases *kapha*, *Medas* (body fat), and *Mutra* which includes overconsumption of foods that are *Ushna* (hot), *Snigdha* (unctuous), and *Guru* (heavy), lack of physical activity, excessive sleep and sedentary behaviours.

**Classification**<sup>[5,6]</sup>

1. Based on predominance of *Dosha*  
*Kaphaja* – 10 types  
*Pittaja* – 6 types  
*Vatika* – 4 types
2. Based on *Nidana*  
*Sahaja* – Congenital/ Hereditary  
*Kulaja* - Disorders that arise due to improper or unhealthy dietary and lifestyle habits
3. Based on body constitution  
*Sthoola Prameha* – In obese individuals  
*Krisha Prameha* - In emaciated individual
4. Based Prognosis  
*Sadhya* - Curable  
*Yapya* - Manageable  
*Asadhya* – Incurable

**Samprapti of Prameha**<sup>[7]</sup>



The vitiated *Doshas* lodge in the *Vasti*, producing *Kapha Prameha*.  
 When *Kapha* decreases, *Pitta-Rakta* increase → *Paittika Prameha*.  
 When *Pitta* decreases, *Vata* increases, settles in *Vasti* → *Vatika Prameha*.

**Samprapti Ghaṭakas** [8]

<b>Dosha</b>	Predominantly <i>Drava-sleshma</i> with involvement of all three <i>Doṣas</i>
<b>Dushya</b>	<i>Rasa, Rakta, Maṃsa, Meda, Majja</i> , along with <i>Kleda</i> and <i>Udaka</i>
<b>Agnibala</b>	Impairment of <i>Dhatu agni</i> and <i>Bhuta agni</i> , leading to digestive and metabolic weakness
<b>Srotas</b>	Mainly <i>Medovaha, Mutravaha, and Udakavaha</i> srotas
<b>Srotodusti</b>	<i>Sanga</i> (obstruction) and <i>Atipravrtti</i> (excessive flow)
<b>Adhithana</b>	Primarily <i>Vasti</i> , with systemic spread
<b>Udbhava Sthana</b>	<i>Koshta</i> , due to <i>Ama</i> formation and impaired digestion
<b>Vyadhi Svabhava</b>	Chronic and long-standing ( <i>Chirakari</i> )

**Selected Yoga Practices Beneficial for the Primary Level Prevention of Type 2 Diabetes Mellitus**

<b>Standing Postures</b>	
1.	<i>Tadasana</i>
2.	<i>Tiryaktadasana</i>
3.	<i>Ardhachakrasana</i>
<b>Sitting Postures</b>	
4.	<i>Paschimothanasana</i>
5.	<i>Ardhamatsyendrasana</i>
6.	<i>Ushtrasana</i>
7.	<i>Vakrasana</i>
<b>Supine Postures</b>	
8.	<i>Pavanamuktasana</i>
9.	<i>Naukasana</i>
10.	<i>Sethubandhasana</i>
11.	<i>Halasana</i>
<b>Prone Postures</b>	
12.	<i>Bhujangasana</i>
13.	<i>Dhanurasana</i>
14.	<i>Salabhasana</i>
15.	<i>Sooryanamaskara</i>
<b>Pranayama</b>	
16.	<i>Suryabhedana</i>
17.	<i>Chandrabhedana</i>
18.	<i>Bhastrika</i>
<b>Kriyas</b>	
19.	<i>Kapalabhati</i>
20.	<i>Vamana Dhauti</i>

**Effect of Selected *Yogasanas* in the Primary Level Prevention of Type 2 Diabetes Mellitus**

S.No.	Yoga Practice	Key Effects in T2DM
1	<i>Tadasana</i>	Improves posture, muscle tone, peripheral circulation; enhances glucose uptake and insulin sensitivity; reduces stress.
2	<i>Tiryak Tadasana</i>	Activates lateral trunk muscles; stimulates pancreas and digestive organs; improves insulin sensitivity and glucose utilization.
3	<i>Ardha Chakrasana</i>	Improves muscle activity and circulation; enhances glucose uptake; reduces insulin resistance.
4	<i>Paschimottanasana</i>	Compresses abdomen, stimulates $\beta$ -cells; enhances insulin secretion; activates parasympathetic system; reduces visceral fat; improves glucose metabolism.
5	<i>Ardhamatsyendrasana</i>	Twisting massages pancreas; improves circulation; enhances insulin secretion and glucose metabolism.
6	<i>Ushtrasana</i>	Activates large muscles; improves glucose uptake; reduces central obesity.
7	<i>Vakrasana</i>	Improves metabolism and weight management; activates parasympathetic system, reducing stress-induced hyperglycemia.
8	<i>Pavanamuktasana</i>	Abdominal compression increases pancreatic circulation; stimulates $\beta$ -cell activity; improves glucose regulation.
9	<i>Naukasana</i>	Strengthens abdominal muscles; enhances pancreatic blood flow; supports insulin secretion.
10	<i>Setubandhasana</i>	Improves venous return; enhances circulation to abdominal organs; improves digestion and <i>Agni</i> ; prevents <i>Kapha-Meda</i> accumulation.
11	<i>Halasana</i>	Abdominal compression and posterior stretch stimulate pancreas/liver; improves insulin sensitivity; enhances parasympathetic activity; regulates <i>Doshas</i> (Ayurvedic perspective).
12	<i>Bhujangasana</i>	Improves muscle tone, circulation, and glucose uptake; reduces visceral fat; maintains fasting/postprandial glucose.
13	<i>Dhanurasana</i>	Compresses pancreas; revitalizes $\beta$ -cells; improves hepatic function and glucose regulation.
14	<i>Shalabhasana</i>	Enhances neuromuscular coordination; improves circulation; reduces cortisol; enhances digestion and glucose utilization.
15	<i>Suryanamaskara</i>	Stimulates large muscles; improves glucose uptake and insulin sensitivity; activates pancreas/liver; enhances parasympathetic activity. <sup>[9]</sup>
16	<i>Suryabhedana</i>	Activates sympathetic system; boosts metabolism and energy utilization; improves circulation and glycaemic control. <sup>[10]</sup>
17	<i>Chandrabhedana</i>	Activates parasympathetic system; reduces stress and cortisol; improves insulin sensitivity and glucose utilization.
18	<i>Bhastrika</i>	Massages pancreas/liver; enhances insulin secretion; reduces visceral fat; balances autonomic system; supports glycaemic control. <sup>[11]</sup>
19	<i>Kapalabhati</i>	Stimulates pancreas; reduces visceral fat; activates <i>Agni</i> ; improves oxygenation and metabolism.
20	<i>Vamana Dhauti</i>	Eliminates excess <i>Kapha/Kleda</i> ; improves <i>Agni</i> ; corrects metabolic imbalance; reduces insulin resistance; supports glycaemic control.

**DISCUSSION**

From a modern scientific perspective, the core pathophysiological mechanisms underlying Type 2 Diabetes Mellitus (T2DM) include insulin resistance, impaired insulin secretion due to  $\beta$ -cell dysfunction, chronic low-grade inflammation, oxidative stress, and autonomic nervous system imbalance. *Yogasanas*,

*pranayama*, and cleansing practices (*Kriyas*) have been shown to influence these mechanisms both directly and indirectly.

Dynamic practices such as *Surya Namaskara* and strength-oriented postures engage large muscle groups, thereby enhancing peripheral glucose uptake

through improved insulin sensitivity. Postures that provide abdominal compression- such as *Paschimottanasana*, *Ardha Matsyendrasana*, *Pavanamuktasana*, *Naukasana*, and *Halasana*-enhance pancreatic circulation and may support  $\beta$ -cell health, thereby contributing to more stable glycaemic control. Forward-bending *Asanas* gently massage and compress the pancreas, potentially stimulating insulin secretion and supporting glucose homeostasis, while backward-bending postures exert an energizing effect on the neuroendocrine system, promoting metabolic vitality. Twisting *Asanas* aid in mobilizing the abdominal viscera, reducing gastrointestinal stasis and improving digestive efficiency. Inverted poses promote enhanced venous return and cerebral circulation, facilitating efficient oxygen and nutrient delivery to endocrine and metabolic organs, thereby contributing to better overall metabolic equilibrium.

*Pranayama* practices also play a pivotal role in autonomic regulation. Techniques such as *Chandra Bhedana*, *Bhastrika*, and *Kapalabhati* facilitate a shift towards parasympathetic dominance and help mitigate sympathetic overactivity, a state associated with elevated cortisol and stress-induced hyperglycaemia. By promoting autonomic balance, these practices support improved insulin action, enhance digestive efficiency, and contribute to overall metabolic homeostasis. In this way, yoga extends its therapeutic influence beyond the musculoskeletal system, addressing the neuroendocrine, autonomic, and psychological dimensions of diabetes prevention and management.

From an Ayurvedic perspective, Type 2 Diabetes Mellitus closely corresponds to *Sthoola Prameha*, a condition arises due to *Kapha-Meda* predominance, *Agnimandya*, and obstruction of bodily channels (*Srotorodha*). The yogic practices selected for intervention demonstrate *Kapha-Medohara* (reducing *Kapha* and adipose tissue), *Agnidipana* (enhancing digestive and metabolic fire), and *Srotoshodhana* (clearing bodily channels) properties, aligning closely with the therapeutic goals described in classical texts.

Postural practices such as *Ushtrasana*, *Dhanurasana*, and *Shalabhasana* help counteract sedentary habits (*Asyasukha*, *Ekasthana asana*). Cleansing techniques such as *Kapalabhati* and *Vamana Dhauti* aid in the elimination of excess *Kleda* (fluid/metabolic waste), facilitating the restoration of metabolic equilibrium. By correcting *Agni* and reducing excessive *Meda*, yoga targets the foundational pathology described in the *Prameha Samprapti*, offering a therapeutic pathway that is both preventive and corrective.

A significant strength of yoga is its accessibility- it is cost-effective, safe, and adaptable for community-level implementation. Simple postures and

breathing techniques can be practiced across age groups, require minimal infrastructure, and carry a low risk of adverse effects when taught correctly. These attributes position yoga as a practical and sustainable preventive strategy, particularly in low- and middle-income populations where access to comprehensive medical care may be limited.

## CONCLUSION

Type 2 Diabetes Mellitus (T2DM) is a predominantly lifestyle-related metabolic disorder characterized by insulin resistance, impaired glucose metabolism, and progressive  $\beta$ -cell dysfunction. Its rising global prevalence highlights the urgent need for preventive strategies that extend beyond conventional pharmacotherapy. This article emphasizes that regular practice of selected *Yogasanas*, *pranayama*, and *kriyas* provides multidimensional benefits in both the prevention and management of T2DM. These practices enhance insulin sensitivity, stimulate pancreatic  $\beta$ -cell activity, improve peripheral glucose utilization, and support hepatic and endocrine function. Simultaneously, they promote autonomic balance by reducing sympathetic overactivity and cortisol levels, thereby mitigating stress-induced hyperglycaemia.

From an Ayurvedic perspective, yoga addresses the fundamental pathological mechanisms of *Sthoola Prameha* by correcting *Agnimandya* (impaired digestive and metabolic fire), reducing excess *Kapha* and *Meda* accumulation, and preventing *Srotorodha* (obstruction in body channels), which collectively contribute to improved metabolic homeostasis. The combination of physical postures, controlled breathing, and mindful practice provides not only physiological benefits but also mental and emotional stability, fostering a holistic approach to health.

Given its safety profile, affordability, and adaptability across diverse community settings, yoga represents a viable non-pharmacological approach for the primary prevention of T2DM. Integrating yoga into daily routines can effectively reduce modifiable risk factors such as sedentary lifestyle, central obesity, chronic stress, and poor metabolic control, thereby lowering disease incidence and burden at both individual and population levels. This holistic model of intervention positions yoga as a complementary, evidence-aligned preventive and therapeutic tool in modern diabetes care, bridging traditional wisdom with contemporary health needs.

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