

## CHAPTER 2

# ANCIENT LITERARY RESEARCH: T2DM PREVENTION AND GLYCEMIC CONTROL ACCORDING TO YOGA

### 2.1 BACKGROUND AND SCOPE

T2DM is a heterogeneous disorder caused by a combination of genetic and lifestyle factors which adversely affect tissue insulin sensitivity and  $\beta$ -cell function. T2DM develops because of progressive  $\beta$ -cell dysfunction, which fails to compensate for acquired insulin resistance. Acquired lifestyle factors that increase diabetes risk include: obesity, sedentary lifestyle, and glucose and lipid toxicity caused by improper nutrition (Holt, Cockram, Flyvbjerg, & Goldstein, 2016).

In the Yogic model, diabetes is a disorder whose origin lies in the mind (*ādhiya vyādhi* – mental disturbances lead to physical disease); the observed pathophysiology is only the final stage of disease development. This model has been developed comprehensively over the last 35 years (Nagendra, 1987; Nagendra & Nagarathna, 2003), and has formed the basis of a highly successful integrated yogic approach to diabetes prevention and management (Nagendra & Nagarathna, 2003). According to this model, the root cause of diabetes and many other highly prevalent non-communicable diseases (NCDs) is excessive stress that is a result of speeded up movements of a reactive mind.

Following the seminal work of H.R. Nagendra (Nagendra, 1987), a number of subsequent researchers have refined and expanded the *ādhiya vyādhi* model, most notably by incorporating the concepts of homeostasis (A. Singh, Tekur, & Nagendra, 2020) and moderation (Venugopal, Mavathur, & Sharma, 2019). The *āyurvedic* concepts of *Prameha*, *Madhumeha*, and

*pañcavāyu* have also been integrated into the model (B. Sharma, Nagendra, & Hankey, 2015; A. Singh et al., 2020).

Notably missing is research into the scriptures of *Haṭha Yoga*. The two most famous writings on *Haṭha Yoga*, the *Gheraṇḍa Saṃhita* and the *Haṭha Yoga Pradīpika*, make repeated mention of the benefits of *Haṭha Yoga* in mitigating both proximate causes of diabetes (such as obesity, overeating, sedentary lifestyle) and the root cause (stress and speeded up mind). There is also a vast corpus of scientific studies that have reported benefits of the various practices of *Haṭha Yoga*, such as *āsana*, *prāṇāyāma*, and *ṣaṭ-karma* for diabetes and its risk factors. (**Note:** the purification practices of *Haṭha Yoga* are referred to as *ṣaṭ-karma* in some texts, and *ṣaṭ-kriya* in other texts. Since our research is going to focus on *Haṭha Yoga Pradīpika*, which uses the former term, we will also use that term henceforth to refer to these practices). Thus, there is a lot of benefit to explore these practices with the specific focus on diabetes and its risk factors. This will be our main objective in this study.

A secondary objective of our research is going to be the creation of a unified medico-yogic map of the pathways (such as encouraging weight loss, stress reduction, etc.) through which Yoga prevents diabetes progression and brings about glycemic control. The end goal is a creation of a comprehensive list of *Haṭha Yogic* practices for each risk factor.

## **2.2 SUMMARY OF EARLIER WORKS ON YOGA AND T2DM**

The modeling of diseases within the framework of Yoga has been studied in many earlier works. One of the most comprehensive explorations of this can be found in the seminal text by Nagendra, which introduces the key concept that most non-communicable diseases are *ādhija*

*vyādhis*, which have stress and excessive movements of the mind as their root cause (Nagendra, 1987).

Various later works have refined and expanded upon this concept. Singh points out in his PhD thesis (Singh et al., 2020) that the Yogic and Ayurvedic models of T2DM pathogenesis can be unified through the concept of homeostasis. He further provides compelling scriptural evidence that it is through the pathway of homeostasis restoration that Yogic techniques help with diabetes prevention and treatment.

A slightly different take is offered by Venugopal in his exploration of the benefits of Yoga in reducing glycemic variability in individuals with diabetes through the practice of Yoga (Venugopal et al., 2019). He demonstrates that the concept of moderation, known as *samatvam* in Yogic literature, when applied to all of the five *kośas*, can be a useful framework of analyzing the effects of Yogic techniques.

Sharma provides a comprehensive theoretical framework for *prāṇāmaya kośa* from both Yogic and Ayurvedic perspectives, with the intent of relating it to measurable bioenergetics and disease (Sharma et al., 2015). The focus is on diabetes, and the main exploration is around the concept of health and disease in terms of *prāṇa* and its functions, especially in relation to *Prameha* and *Madhumeha*.

Indira Rao, in her 2014 thesis, takes a novel approach to Yoga and Diabetes (Rao, Subrahmanyam, & Nagendra, 2014). She investigates the salutary effects of music on individuals with diabetes and investigates shows how the techniques of yoga aid in the development of voice.

## 2.3 AIM AND OBJECTIVES

The aim of this literary research is to study classic texts on Yoga, with a particular focus on *Haṭha Yoga* to see if they describe techniques for diabetes prevention and glycemic control.

Our specific objectives are:

- To create a medico-yogic map of the pathways through which Hatha Yoga techniques help in diabetes prevention and glycemic control
- To compile specific *āsanas*, *ṣaṭ-karmas*, and *prāṇāyāmas* which for each risk factor

## 2.4 MATERIALS AND METHODS

### 2.4.1 Source materials

The following texts were reviewed for this study:

1. *Haṭha Yoga Pradīpika* (Akers, 2012; Vishnudevananda, 1987)
2. Commentary *Jyotsnā of Brahmānanda on Haṭha Yoga Pradīpika* (Svātmārāma & Aiyangar, 1893)
3. *Yoga Sūtras* (Adidevananda, 1970; Satchidananda, 2004)
4. *Vyāsa Bhāṣya* (commentary) on the *Yoga Sūtras* (Satchidananda, 2004)
5. *Yoga Vāsiṣṭha* (Arya, 1998; Venkatesananda, 1993)
6. *Bhagavadgīta* (Gambhirananda, 1997)

## **2.4.2 Methods**

A medico-yogic model of diabetes progression was developed, identifying three levels: physiological manifestation, proximal causes, and root cause. For each of the proximal causes and the root cause, the aforementioned scriptural literature was investigated, and a list of *Haṭha Yogic* techniques were compiled. Using this information, a map was constructed of the pathways through which these techniques bring about diabetes prevention and glycemic control.

## **2.5 MODELS OF DIABETES PROGRESSION**

### **2.5.1 Medical model**

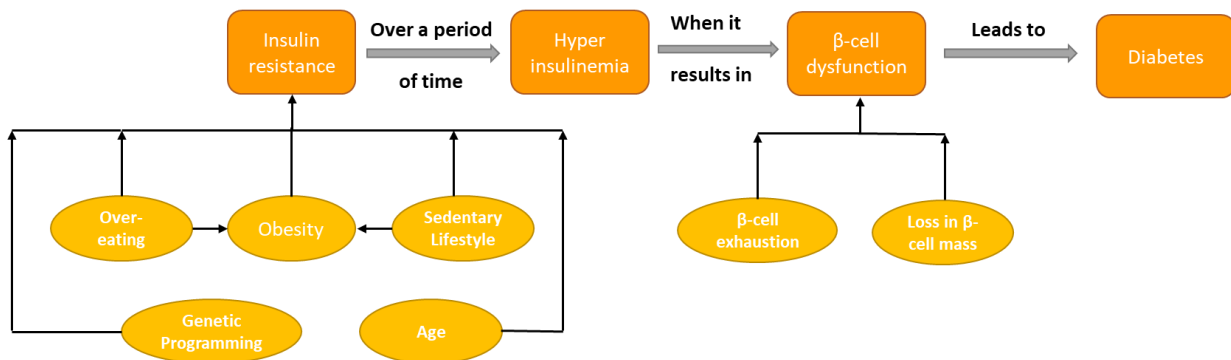
The accepted model of diabetes progression according to the latest medical evidence (Holt et al., 2016) indicates the progression to diabetes begins as insulin resistance, leading to hyperinsulinemia; when hyperinsulinemia is accompanied by  $\beta$ -cell dysfunction, it leads to T2DM.

Insulin is an anabolic hormone secreted by  $\beta$ -cells in a region of the pancreas known as *Islets of Langerhans*. The primary effect of insulin is to control the amount of glucose in the blood. It achieves this effect via three broad mechanisms: (a) in the skeletal muscle, it stimulates glucose transport into it, and encourages glucose storage as glycogen (b) in the liver, it lowers hepatic glucose output by inhibiting glycogenolysis and gluconeogenesis, and augments glycogen formation (c) in adipocytes, insulin promotes glucose uptake, glycerol synthesis, and triglyceride formation.

Some individuals develop insulin resistance, which is the inability of insulin to produce its usual biologic actions at circulating concentrations. Insulin resistance results in impaired suppression of endogenous glucose production, and to reduced peripheral uptake of glucose.

In response to this, the pancreas begins to secrete more insulin, leading to chronically elevated levels of insulin in the blood stream. This is a condition is known as *hyperinsulinemia*. Insulin resistance has multiple risk factors: obesity, genetic programming, poor diet due to high nutrient availability, age, and hormonal factors often related to stress.

There are many people who have hyperinsulinemia but do not progress to diabetes (Shanik et al., 2008). But in some individuals, a second factor comes into play: *β-cell dysfunction*. Due to continuously high demand for insulin, β-cells of the pancreas, which are responsible for producing insulin, either become less efficient in producing it (this is known as *β-cell exhaustion*), and/or the pancreas begins to lose β-cell mass. This latter condition is often due to an auto-immune response. β-cell dysfunction, when combined with insulin resistance, leads to overt hyperglycemia, or type 2 diabetes (see Fig 2).

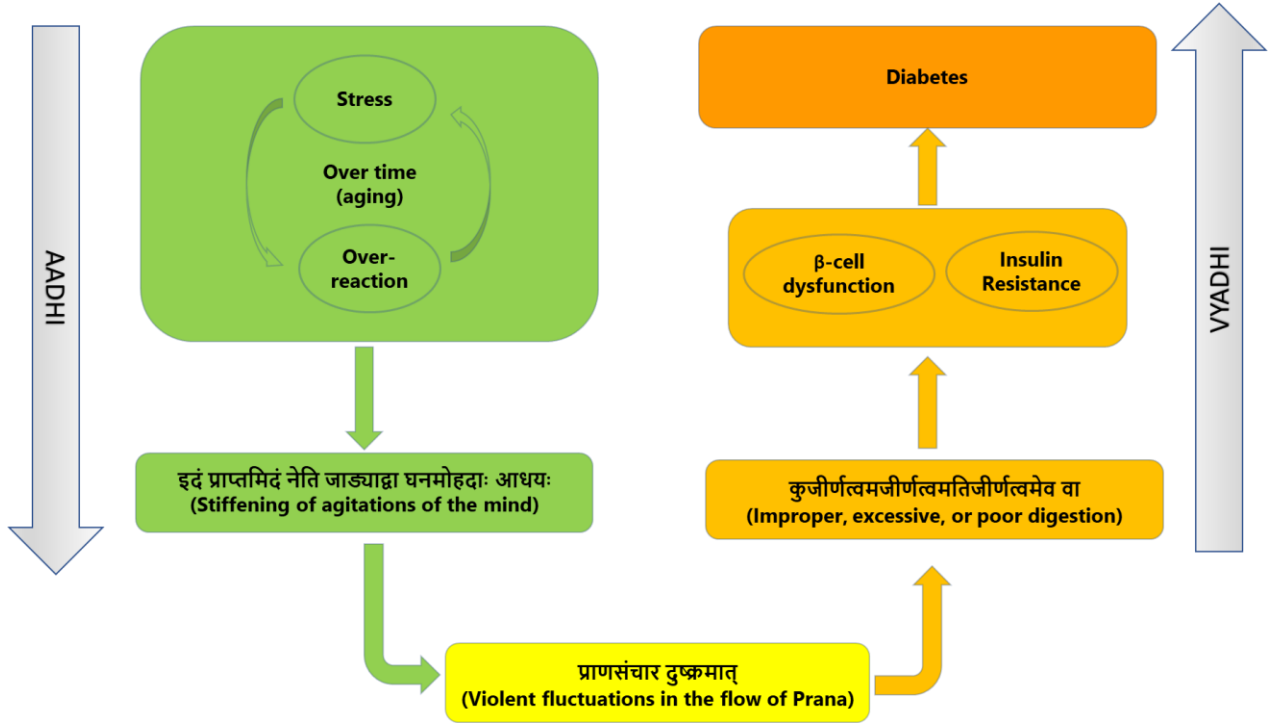


**Fig 2: Medical model of diabetes progression**

### 2.5.2 Yogic model

The yogic model of diabetes progression is shown in Fig 3, from entrenched mental disturbances (*ādhi*) to manifest physical maladies (*vyādhi*) (Nagendra & Nagarathna, 2003).

When the mind is agitated due the ups and downs of daily life, it causes stress. From the perspective of *manomaya kośa* (the body of thoughts and emotions), stress is the uncontrolled and rapidly repeating flow of thoughts in the mind.



**Fig 3: Yogic model of diabetes progression**

Yoga says that it is not outward circumstance, but our *reaction* to it that determine their effect on us. When we over-react to outward circumstance, it increases stress, which in turn increases the strength of our reaction, and so on – setting up a vicious cycle of self-amplification. Over time – i.e., as we age – these mental imbalances stiffen and become *ādhis*. The *Yoga Vāsiṣṭha* captures the process in the following shloka:

इदं प्राप्तमिदं नेति जाड्याद्वा घनमोहदाः

आधयः संप्रवर्तन्ते वर्षासु मिहिका इव

*Idaṃ prāptamidaṃ neti jāḍyādvā ghanamohadāḥ*

*Ādhayaḥ saṃpravartante varṣāsu mihikā iva*

(Yoga Vāsiṣṭha 6(1).81:16)

**As a result of exulting about what you have, worrying about what you don't mental imbalances stiffen and thicken, rising up to the surface like vapour during rainy season**

These *ādhis* are transferred from *manomaya* to *prāṇāmaya kośa*, resulting in excessive flow of prana through the *nādis*. This in turn disturbs the delicate balance of the peristaltic process, causing improper, poor, or excessive digestion. This process is captured in *Yoga Vāsiṣṭha* in the following verses:

कुजीर्णत्वमजीर्णत्वमतिजीर्णत्वमेव वा  
दोषायैव प्रयात्यन्नं प्राणसंचार दुष्क्रमात्

*Kujīrṇatvamajīrṇatvamatijīrṇatvameva vā*

*Doṣāyaiva prayātyannaṃ prāṇasaṃcāra duṣkramāt*

(Yoga Vāsiṣṭha 6(1).81:34)

**This disturbance of prana in Nadis results in irregular, incomplete, or excessive digestion.**

यान्यन्नानि विरोधेन तिष्ठन्त्यन्तः शरीरिके  
तान्येव व्याधितां यान्ति परिनामस्वभावतः

*Yānyannāni virodhena tiṣṭhantyaṅtaḥ śarīrike*

*Tānyeva vyādhitāṃ yānti parināmasvabhāvataḥ*

(Yoga Vāsiṣṭha 6(1).81:36)

**The badly digested food, which settles down in the body amidst such commotion, is transformed into diseases.**

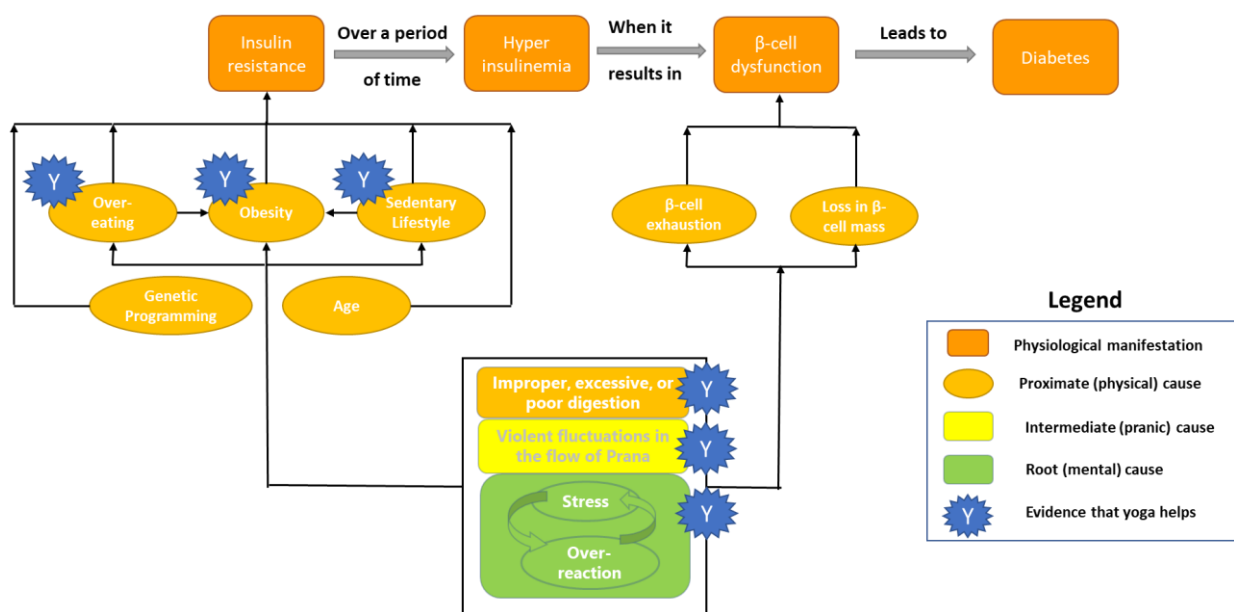
Uncontrolled mental speed leads to uncontrolled physical speed – fighting at the cell wall, which is insulin resistance. It also leads to autoimmune response and thus to  $\beta$ -cell dysfunction, which over the course of a few years leads to diabetes.

### 2.5.3 Medico-yogic model showing proximate, intermediate, and root causes

Yoga helps prevention of diabetes and brings about glycemic control through multiple pathways, which include both proximate causes such as obesity, etc., but also through mitigation deeper causes such as excessive fluctuation of prana and uncontrolled speed of thoughts, leading to the root cause, which is stress. Fig 4 integrates causes from both medical

and yogic model, organizing them in a hierarchy of proximate, intermediate, and root causes. Also shown in the figure are the areas in which we find scriptural evidence that yoga is beneficial.

*Haṭha* Yogic techniques address both proximate (physical) causes and risk factors of diabetes. They also help mitigate issues higher up the chain of causation, at the intermediate (*prāṇic*) and root (mental) levels.



**Fig 4: Integrated model of diabetes showing proximate, intermediate, and root causes**

## 2.6 HAṬHA YOGA TECHNIQUES FOR PROXIMATE CAUSES

We can find evidence in ancient Yogic texts that Yoga helps with the following proximate causes/risk factors for diabetes:

- Improving digestion
- Helping reduce obesity
- Changing from a sedentary to active lifestyle
- Help in avoiding over-eating

Our scriptural examination will focus primarily on the famous text, the *Haṭha Yoga Pradīpika* (*HYP*). It was written some time in 15<sup>th</sup> Century CE. The author is a yogi by the name of *Svātmārāma*. The citations presented here refer to the manuscript from Adyar Library, which is the most commonly translated and published version of *HYP* (Akers, 2012; Vishnudevananda, 1987).

### 2.6.1 Improving Digestion

Many yogic practices are considered to be helpful in improving digestion, primarily through the mechanism of stimulating or increasing the digestive fire (जठरानल). *Haṭha Yoga Pradīpika* is replete with practices that achieve this purpose. Given below are some of the most important ones.

मत्स्येन्द्रपीठं जठरप्रदीप्तिम् प्रचण्डरुग्मण्डल खण्डनास्त्रम्  
अभ्यासतः कुन्दलिनिप्रबोधं चन्द्रस्थिरत्वं च ददाति पुंसां

*Matsyendrapīṭham jaṭharapradīptim praçaṇḍarugmaṇḍala khaṇḍanāstram*

*Abhyāsataḥ kundaliniprabodham candrasthiratvaṃ ca dadāti puṃsām*

(*Haṭha Yoga Pradīpika* 2:27)

***Matsyendrāsana* increases the appetite by fanning the gastric fire and destroys terrible diseases in the body. When practiced, it rouses *Kuṇḍalini* and makes the moon steady.**

इति पश्चिमतानमासनाग्र्यं पवनं पश्चिमवाहिनं करोति  
उदयं जठरानलस्य कुर्यादुदरे काश्यमरोगतां च पुंसां

*Iti pascimatānamāsanāgryaṃ pavanaṃ paśchimavāhinaṃ karoti*

*Udayaṃ jaṭharānalasya kuryādudare kāśryamarogatāṃ ca puṃsām*

(*Haṭha Yoga Pradīpika* 1:29)

**This *pascimatānam* is the foremost among *āsanas*. It reverses the downward flow of *vāyu*, awakens the gastric fire, makes the stomach lean, and removes all diseases.**

हरति सकलरोगानाशु गुल्मोदरादि  
नाभिभवति च दोषानासनं श्री मयूरम्  
बहु कदशनभुक्तं भस्म कुर्यदशेषं  
जनयति गथराग्निं जारयेत्कालकूटं

*Harati sakalarogānāśu gulmodarādi*

*Nābhibhavati ca doṣānāsanam śrī mayūram*

*Bahu kadaśanabhuktaṃ bhasma kuryadaśeṣam*

*Janayati gatharāgniṃ jārayetkālakūṭam*

(Haṭha Yoga Pradīpika 1:31)

**Śrī mayūrāsana cures diseases of the stomach, glands, and spleen, and removes all diseases caused by excess of humors. It stimulates gastric fire, easily digests food eaten immoderately, and reduces to ashes even the terrible poison kālakūṭa.**

मन्दाग्निदीपनपाचनादिसन्धापिकानन्दकरी सदैव  
अशेषदोषामयशोषणी च हठक्रियामौलिरियं च नौलिः

*Mandāgnidīpanapācanādīsandhāpikānandakarī sadaiva*

*Aśeṣadoṣāmayaśoṣaṇī ca haṭhakriyāmauliriyam ca nauliḥ*

(Haṭha Yoga Pradīpika 2:34)

**This Nauli, the crown of Hatha Yoga practices, drives away the dullness of the gastric fire, increases digestive power, always brings happiness, and destroys all diseases and disorders of the humors.**

पोर्वत्कुम्भयेत्प्राणम् रेचयेदिडया तथाः

श्लेश्मदोशहरं कण्ठे देहानलविवर्धनम्

*Paurvatkumbhayetprāṇam recayedidayā tathāḥ*

*Śleśmdośaharam kaṇṭhe dehānalavivardhanam*

(Haṭha Yoga Pradīpika 2:52)

**(Describing Ujjāyi pranayama): perform kumbhaka as before and exhale through Iḍa (left). This removes diseases in the throat caused by phlegm and stimulates the gastric fire in the body.**

नित्यमभ्यासयुक्तस्य जठराग्निविवर्धिनी

आहारो बहुलस्तस्य संपाद्यः साधकरस्य च

*Nityamabhyāsasyuktasya jaṭharāgnivivardhini*

*Āhāro bahulastasya saṃpādyah sādhanakasya ca*

(Haṭha Yoga Pradīpika 3:80)

**(Describing the effect of Viparīta Karaṇi Mudra) Daily practice increases gastric fire, so the practitioner should have plenty of food**

As can be seen, there are *āsanas*, *prāṇāyāmas*, *karmas*, and *mudras* to stimulate gastric fire and improve digestion. In fact, the *HYP* goes on to say that a vigorous gastric fire is one of the outcomes of *Haṭha Yoga*.

**वपुः कृशत्वं वदने प्रसन्नता नादस्फुतत्वं नयने सुनिर्मले**

**अरोगता बिन्दुजयोऽग्निदीपनं नाडिविशुद्धिर्हठ सिद्धिलक्षणम्**

*Vapuḥ kṛśatvaṃ vadane prasannatā nādasphutatvaṃ nayane sunirmale*

*Arogatā bindujayoḥSgnidīpanam nādiviśudhirhaṭha siddhilakṣaṇam*

(Haṭha Yoga Pradīpika 2:78)

**The indicators of success in Hatha are: leanness of the body, clearness of face, distinctness of *nāda*, very clear eyes, health, victory over *bindu*, a vigorous digestive fire, and purity of *nādis*.**

Therefore, we may conclude that the practices of *Haṭha Yoga* are one of the best ways to reverse the effects improper digestion (*ajīrṇatvam*, *atijīrṇatvam*, and *kujīrṇatvam*) caused by *ādhis* in the form of stress induced by speeded-up mind.

## 2.6.2 Reducing Obesity

The *HYP* informs us in chapter 1 that the practice of *āsanas* (yoga postures) brings about a reduction in body weight:

**हठस्य प्रथमाङ्गं त्वादासनं पूर्वमुच्यते**

**कुर्यात् तदासनं स्थैर्यमारोग्यं चान्नालाघवः**

*Haṭhasya prathamāṅg tvādāsanam pūrvamucyate*

*Kuryāt tadāsanam sthairyamārogyam cāngalāghavaḥ*

(Haṭha Yoga Pradīpika 1:17)

**Āsanas are described first because they are the first step of Haṭha Yoga. They give steadiness, health, and lightness of body.**

In the *Jyotsna* commentary of *Brahmānanda* (Vishnudevananda, 1987), the reason is given for how asanas produce lightness of the body:

**गौरवरुप तमोधर्मनाशकत्वम्**

*Gauravarupa tamodharmanāśakatvam*

(Jyotsna of Brahmānanda)

**Heaviness of the body arises from the preponderance of *tamas*, which is destroyed [by āsana]**

In chapter 2, HYP states that the practice of *nādi śuddhi* – cleansing of channels of energy in the *prāṇāmaya kośa* – brings about weight loss:

**यदा तु नादिषुद्धिः स्यात्तथा चिन्हानि बाह्यतः**

**कायस्य कृशता कान्तिस्तदा जायेत निश्चितम्**

*Yadā tu nādiśuddhiḥ syāttathā cinhāni bāhyataḥ*

*Kāyasya kṛśatā kāntistadā jāyeta niścitam*

(Haṭha Yoga Pradīpika 2:19)

**When the *nādis* are purified, the consequent signs perceptible, i.e. the body becomes lean and bright.**

Later in chapter 2, HYP states that the practice of *ṣaṭ-karma* is to be done by those who are obese:

**मेदश्लेष्माधिकः पूर्वं षट्कर्माणि समाचरेत्**

**अन्यास्तु नाचरेतानि दोषाणां संभावतः**

*Medaśleṣmādhikāḥ pūrvam ṣaṭkarmāṇi samācaret*

*Anyāstu nācāretāni doṣāṅām saṃbhāvataḥ*

(Haṭha Yoga Pradīpika 2:21)

**One who has too much fat or phlegm should first practice the six *karmas* (*neti, dhauti, etc.*). Others, who do not have these defects, need not as the three humors are equal in them.**

It goes on to say:

षट्कर्म निर्गतस्थौल्यकफदोषमलादि कः

प्राणायामं ततः कुर्यादनायासेन सिद्धियति

*Ṣaṭkarma nirgatasthāulyakaphadoṣamalādi kaḥ*

*Prāṇāyāmaṃ tataḥ kuryādanāyāsena sidhdiyati*

(Haṭha Yoga Pradīpika 2:36)

**With fat, phlegm, and impurities removed by the performance of the six *karmas*, one succeeds very easily if one performs pranayama afterwards.**

Thus we see clear evidence in *Haṭha Yoga Pradīpika* that each of the 3 major practices of *Haṭha Yoga* – *āsanas*, *prāṇāyāmas*, and *ṣaṭ-karmas* – help to reduce obesity. *Asanas* do this by removal of *tamo-guṇa*; *prāṇāyāmas* achieve this by purifying the *nādis*; and *ṣaṭ-karmas* are a direct means of reducing obesity.

### 2.6.3 Overcoming the sedentary lifestyle habit

A sedentary lifestyle is a result of several factors: a job that does not require much movement, modern conveniences (from cars to kitchen appliances) that have eliminated the need to walk or vigorous physical activity; aches and pains which make it hard for one to get exercise; overwork, family pressures, increased commute time which make it hard to make time for exercise, and other factors.

Furthermore, a large number of people actually want to do exercise but find it hard to sustain this once the initial enthusiasm fades away. This is a result of आलस्य (*ālasya* – laziness), and is noted by Maharshi Patanjali as one of the nine चित्त विक्लेष (*citta vikṣhepa* – distractions).

The HYP gives us two practices that eliminate *ālasya* from the mind: a purification practice known as *trātaka* and a pranayama known as *sītakāri*:

निरीक्षेत्रिश्लक्ष्णं सुक्ष्मलक्ष्यं समाहितः  
अश्रुसंपातपर्यन्तमाचार्यैस्त्राटकम् स्मृतं

*Nirīkṣenniścladr̥ṣā suksmalakṣyaṃ samāhitah*  
*Aśrsampātaparyantamācāryaistrāṭakam smṛtaṃ*

(Haṭha Yoga Pradīpika 2:31)

**Gaze with motionless eyes and concentration at a minute point until tears flow. This is called *trātaka* by the gurus.**

मोचनं नेत्ररोगाणाम् तन्द्रादिनां कपाटकम्  
यत्नतस्त्राटकम् गोप्यं यथा हाटकपेटकम्

*Mocanaṃ netrarogāṇām tandrādināṃ kapāṭakam*  
*Yatnatastrāṭakam gopyaṃ yathā hāṭakapēṭakam*

((Haṭha Yoga Pradīpika 2:32)

***trātaka* removes eye diseases, and it is as a closed door to laziness, etc. Strive to keep it a secret, as if it were a gold box. Note: The word तन्द्रा (*tandra*) means laziness, lassitude, and exhaustion**

योगिनी चक्रसंमन्य सृष्टिसंहारकारकः  
न क्षुधा न तृषा निद्रा नैवालस्यं प्रजायते

*Yoginī cakrasaṃmanya sṛṣṭisaṃhārahārahā*  
*Na kṣudhā na tṛṣā nidrā naivālasyaṃ prajāyate*

(Haṭha Yoga Pradīpika 2:55)

**(Describing the effects of *sītakāri* prāṇāyāma): Respected by all yoginis, maker of creation and destruction, neither hunger, nor thirst, nor sleep, nor laziness will appear.**

Thus, the practices of *Haṭha Yoga* by relieving us of the burden of laziness and lethargy, make it easier to overcome a sedentary lifestyle and transition to a habit of active living.

#### 2.6.4 Making better dietary choices

Increased nutrient availability, combined with chronic stresses that are part of daily life, make it hard to eat the right amount or the right kind of food. The practices of *Haṭha Yoga* help in two ways: (a) by reducing hunger and (b) by moving from a *tāmasic/rājasic* mindset to a *sātvik* mindset, causing one to eat moderately.

Let us first examine the practices that help reduce hunger. Three practices are given in *HYP* for achieving this outcome: *khecari mudra*, *sitakāri* and *śīṭali prāṇāyāma*.

न रोगो मरणं तन्द्रा न निद्रा न क्षुधा तृषा  
न च मूर्च्छा भवेत्तस्य यो मुद्रां वेत्ति खेचरिम्

*Na rogo maraṇaṃ tandrā na nidrā na kṣudhā tṛṣā*

*Na ca mūrccā bhavettasya yo mudrāṃ vetti khecarim*

((*Haṭha Yoga Pradīpika* 3:39)

**He who knows *khecari mudra* is without disease, death, laziness, sleep, hunger, thirst, or fainting.**

योगिनी चक्रसंमन्य सृष्टिसंहारकारकः

न क्षुधा न तृषा निद्रा नैवालस्यं प्रजायते

*Yoginī cakrasaṃmanya sṛṣṭisaṃhārakārah*

*Na kṣudhā na tṛṣā nidrā nāvālasyaṃ prajāyate*

((*Haṭha Yoga Pradīpika* 2:55)

**(Describing the effects of *sitakāri prāṇāyāma*): Respected by all yoginis, maker of creation and destruction, neither hunger, nor thirst, nor sleep, nor laziness will appear.**

गुल्मप्लीहदिकान् रोगान् ज्वरं पित्तं क्षुधां तृषाम्

विषाणि शीतली नाम कुम्भकेयं निहन्ति हि

*Gulmaplihadikān rogān jvaraṃ pittam kṣudhāṃ tṛṣām*

*Viṣāṇi śīṭalī nāma kumbhakeyaṃ nihanti hi*

(Haṭha Yoga Pradīpika 2:59)

**This *kumbhaka* named *śīṭali* destroys enlargement of the glands or spleen, other diseases, fever, bile, hunger, thirst, and poisons.**

In the *Jyotsna* commentary of *Brahmānanda* (Vishnudevananda, 1987), the author has pointed out in his commentary on HYP 1:17 that:

आसनेन रजो हन्ति इति वाक्यात्  
गौरवरुप तमोधर्मनाशकत्वम्प्येते नोक्तम्

*Āsanena rajo hanti iti vākyaāt*

*Gauravarupa tamodharmanāśakatvampyete noktam*

(*Jyotsna* commentary of *Brahmānanda*)

**Āsana kills rajo guṇa. Heaviness of the body arises from the preponderance of tamas, which is destroyed [by āsana]**

When *tamo* and *rajo guṇas* reduce, *sattva guṇa* predominates, and the mind automatically gravitates towards eating *sātvic* foods. These include fresh fruits, whole grains, fresh cow milk, etc. Such foods give strength from within and nourish the consciousness. Gravitating towards wholesome *sātvic* foods automatically reduces over-eating.

## 2.7 HAṬHA YOGA TECHNIQUES FOR INTERMEDIATE AND ROOT CAUSES

As detailed in previous sections, the causative agent behind diabetes progression is speed at the mental and *prāṇic* levels. There are several yogic techniques that help slow down the *prāṇic* fluctuations and uncontrolled speeded up thoughts in the mind.

Directly attempting to slow down the mind is very difficult, as we see from Arjuna's appeal to Kṛṣṇa:

चञ्चलं हि मनः कृष्ण प्रमाथि बलवद्दृढम्  
तस्याहं निग्रहं मन्ये वायोरिव सुद्रिष्करम्

*Cañcalaṃ hi manaḥ kṛṣṇa pramāthi balavaddṛḍham*

*Tasyāhaṃ nigrahaṃ manye vāyoriva sudriṣkaram*

(Bhagavadgīta 6:34)

**Verily (Arjuna continued) the mind is restless, tumultuous, powerfully stubborn!  
O Kṛṣṇa, I consider it to be as difficult to master as the wind!**

The HYP provides several indirect methods for this purpose. These techniques are known as *upāya* – which literally means an expedient or an indirect approach to a goal (one might think of this as a trick).

### 2.7.1 Resting the mind

In HYP, we find the following on the benefits of *Savasana*:

उत्तानं शववद्भूमौ शयनं तच्छवासनम्  
शवासनं श्रान्तिहारं चित्तविश्रान्तिकारकम्

*Uttānaṃ śavavadbhūmau śayanaṃ tacchavāsanam*

*Śavāsanam śrāntihāraṃ cittaviśrāntikārakam*

(Haṭha Yoga Pradīpika 1:32)

**Lying upon one's back on the ground at full length like a corpse is called *śavāsana*. It removes fatigue and gives rest to the mind**

### 2.7.2 Reducing reactive tendencies

According to Maharshi Patanjali, the goal of all *āsanas*, when done properly, is to make the mind unaffected by the ups and downs of life – in other words, reduce the reactive tendencies that exacerbate our stress when faced with the vicissitudes of life:

ततो द्वन्दानभिघातः

*Tato dvandānabhighātaḥ*

(Yoga Sūtra 2:47)

शीतोष्णादिभिर्द्वैरासनजयान्नाभिभूयते

*Śītoṣṇādibhirdvairāsanajayānnābhībhūyate*

(Vyāsa's commentary)

**Thereafter one is no longer disturbed by dualities**

**One who has established achieved victory over (i.e. mastered) āsanās is no longer disturbed by dualities such as hot and cold, etc.**

### 2.7.3 Stilling the mind

The third *upāya* is *prāṇāyāma*. Movements of the breath are linked to movements of the mind in a deep and fundamental way. HYP describes this connection as follows:

चले वाते चले चित्तं निश्चले निश्चलं भवेत्  
योगीस्थाणुत्वमाप्नोति ततो वायुं निरोधयेत्

*Cale vāte cale cittam niścale niścalaṃ bhavet*

*Yogīsthāṇutvamāpnoti tato vāyum nirodhayet*

(Haṭha Yoga Pradīpika 2:2)

**When the breath is unsteady, the mind is unsteady. When the breath is steady, the mind is steady, and the yogi becomes steady. Therefore, one should restrain the breath.**

Paramhansa Yogānanda describes the connection in chapter 26 of his spiritual classic *The autobiography of a Yogi* (Yogananda, 1946):

*The ancient yogis discovered that the secret of cosmic consciousness is intimately linked with breath mastery...the life force, which is ordinarily absorbed in maintaining the heart pump, must be freed for higher activities by a method of calming and stilling the ceaseless demands of the breath*

(AY Chapter 26, "The Science of Kriya Yoga")

Thus, the aim of all *prāṇāyāma* techniques is to still the mind. The diversity of these techniques ensures that a suitable one can be found to suit almost any physical limitation. Maharshi Patanjali makes the connection between a steady mind and *pranayama* very clear:

धारणासु च योग्यता मनसः

*Dhāraṇāsu ca योग्यता मनसः*

(Yoga Sūtra 2:52)

**(As a result of prāṇāyāma practice) The mind becomes fit for concentration.**

Concentration – *dhāraṇā* – is the ability for the mind to hold a single thought or object of focus.

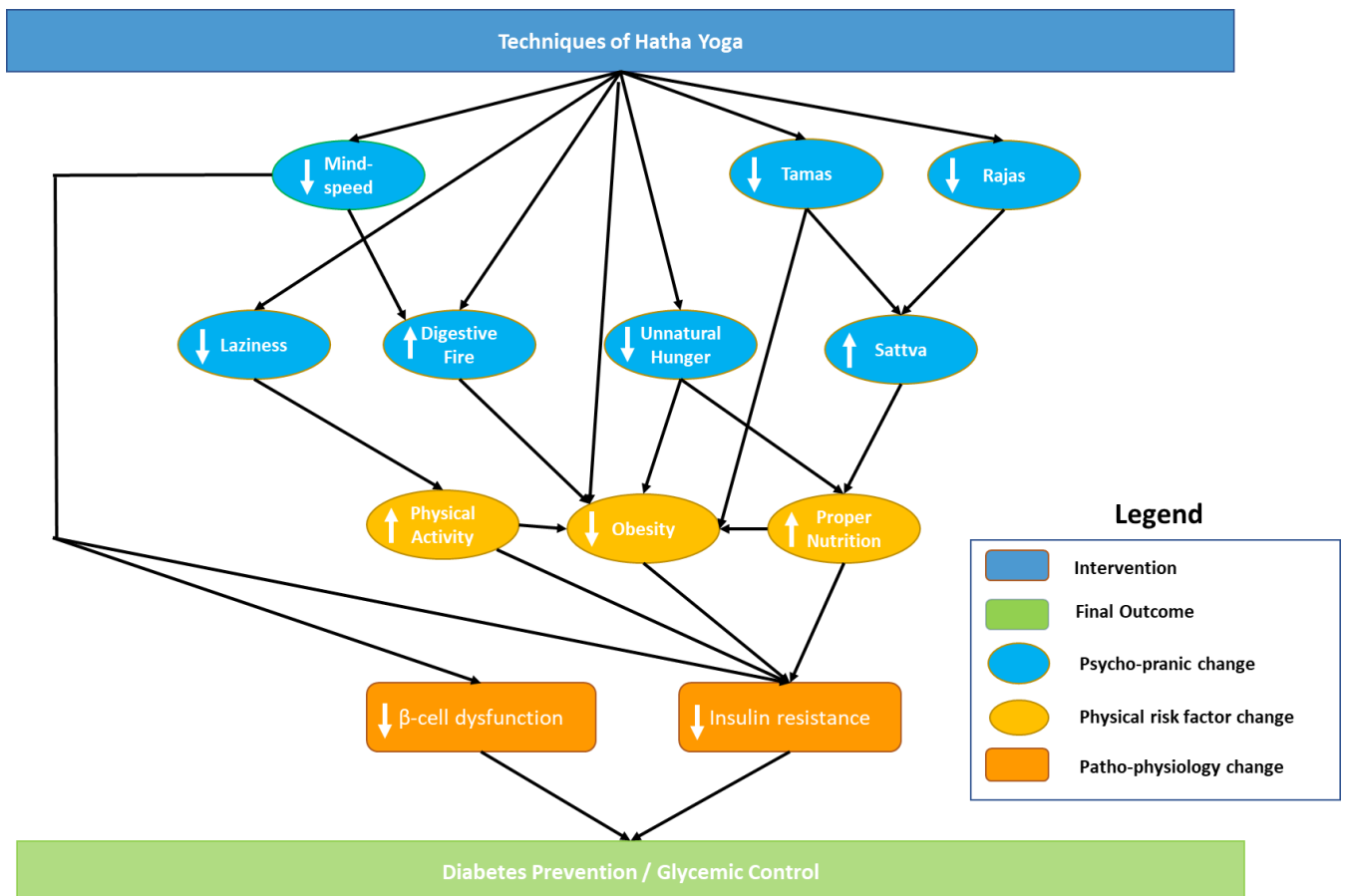
In other words, concentration is simply another way of saying that the mind is still. Thus, in the above Yoga Sutra, Maharshi Patanjali is saying that the end result of *prāṇāyāma* is stillness of the mind.

## **2.8 PATHWAYS THROUGH WHICH YOGA PREVENTS/TREATS**

### **T2DM**

Our analysis of *Haṭha Yoga Pradīpika* and *Yoga Sūtra* have brought forth a plethora of techniques whose end-outcome is to either improve insulin sensitivity or reduce  $\beta$ -cell dysfunction. Thus, we may consider these techniques to contribute towards prevention of diabetes progression in high-risk individuals or, among individuals who have diabetes, towards effecting glycemic control.

These pathways are illustrated in Fig 5.



**Fig 5: Map of the pathways through which *Haṭha Yoga* effects diabetes prevention and glycemic control**

## **2.9 SUMMARY OF HAṬHA YOGA TECHNIQUES & THEIR EFFECTS**

We now provide a summary, for each outcome, the list of techniques according to the Yogic scriptures. This is meant to serve as a reference to both future researchers and for active Yoga teachers.

**Table 2: Catalogue of techniques for various salutary outcomes related to diabetes**

<b>Outcome</b>	<b>List of techniques</b>
Improved digestion	<i>Matsyendrāsana, Pascimatānam, Mayūrāsana, Nauli, Ujjāyi pranayama, Viparīta Karaṇi mudra</i>
Reducing Obesity	<i>All āsanās, nādi śuddhi, ṣaṭ-karma</i>
Enabling an active lifestyle	<i>Trātaka, Sītakāri prāṇāyāma</i>
Encouraging proper nutrition	<i>Khecari mudra, Sītakāri prāṇāyāma, śitali prāṇāyāma, all āsanās</i>
Stilling the mind and reducing reactivity	<i>All āsanās but especially śavāsana, all Prāṇāyāmas</i>

## 2.10 CONCLUSION

We have examined how six yogic practices mitigate the six causes/risk factors for diabetes, drawing from the following sources: *Haṭha Yoga Pradīpika, Yoga Vāsiṣṭha, Bhagavadgīta*, and the *Yoga Sūtras*, along with *Vyāsa Bhāṣya* and *Jyotsna of Brahmānanda*.

**Table 3: Summary of Yogic Techniques and their effects on diabetes risk factors**

	<b>Obesity</b>	<b>Poor Diet</b>	<b>Sedentary Lifestyle</b>	<b>Improper digestion</b>	<b>Stress (sped up thoughts)</b>	<b>Excessive reactivity</b>
<b>ṣaṭ-karma</b>	✓		✓	✓		
<b>āsana</b>	✓	✓		✓	✓	
<b>prāṇāyāma</b>	✓	✓	✓	✓	✓	
<b>Mudra</b>		✓		✓		
<b>Dhyāna</b>						✓

The scriptures of Yoga give us a clear model of how and which *Haṭha Yogic* practices help with mitigating diabetes risk and aid in glycemic control. In particular, the *HYP* has a plethora

of *upāyas* that not only mitigate the proximate risk factors at the physical level, but also mitigate the root cause.

From the perspective of public health, the ease, accessibility and safety of an intervention is just as important as its effectiveness. The *Bhagavadgīta* gives us great reassurance in this regard:

नेहाभिक्रमनाशोऽस्ति प्रत्यवायो न विद्यते  
स्वल्पमप्यस्य धर्मस्य त्रायते महतोभयात्

*Nehābhikramanāśosti pratyavāyo na vidyate*  
*Svalpamapyasya dharmasya trāyate mahatobhayāt*

(Bhagavadgīta 2:40)

**In this path (of Yoga) there is no wasted effort; nor is there (any) harm. Even a little bit of this practice will free one from dire fears and colossal sufferings.**