INTERNATIONAL JOURNAL OF
Clinical and Pharmaceutical Innovations
An International Peer Reviewed Open Access Journal

Research Article

ISSN (Online): 3142-8665

2026, Volume 1, Issue 3, Page No: 68-74.

A MULTI-MODAL AYURVEDIC INTERVENTION COMBINING PANCHAKARMA, HERBAL MEDICATION, AND CALORIE-RESTRICTED DIET FOR TYPE 2 DIABETES MELLITUS:

Dr. Rohit Sane[1], Dr. Gurudatta Amin[2], Dr. Pravin Ghadigaonkar[3], Dr. Priyadarshini Bhalekar*[4], Dr. Sneha Patil[5]

[1]MD and CEO, Vaidya Sane Ayurved Laboratories Limited.
[2]Chief Medical Officer, Vaidya Sane Ayurved Laboratories Limited.
[3]Head Medical Operations, Vaidya Sane Ayurved Laboratories Limited.
[4]Zonal Medical Head, Madhavbaug Clinics, Maharashtra, India.
[5]Clinic Head, Madhavbaug Kharadi Clinic, Pune, Maharashtra, India.

Article Info: **Received:** 16 April 2026, **Revised:** 06 May 2026, **Accepted:** 26 May 2026

***Corresponding Author: Dr. Priyadarshini Bhalekar**

Zonal Medical Head, Madhavbaug Clinics, Maharashtra, India.

Citation:
Dr. Rohit Sane[1], Dr. Gurudatta Amin[2], Dr. Pravin Ghadigaonkar[3], Dr. Priyadarshini Bhalekar*[4], Dr. Sneha Patil[5]. (2026). A Multi-Modal Ayurvedic Intervention Combining Panchakarma, Herbal Medication, And Calorie-Restricted Diet For Type 2 Diabetes Mellitus:. International Journal of Clinical and Pharmaceutical Innovations, 1(3), 68-74.
DOI: https://doi.org/10.5281/zenodo.20474407

ABSTRACT
Type 2 Diabetes Mellitus (T2DM) is a growing metabolic disorder with rising global prevalence. Conventional pharmacological management, while effective, is often associated with long-term side effects and medication dependence. Ayurveda offers a holistic approach to Prameha (diabetes) through multi-modal interventions. This study evaluates clinical outcomes of an integrated Ayurvedic protocol combining individualized Panchakarma therapies, oral herbal medications, and a structured low-calorie diet in patients with T2DM. This retrospective observational study analyzed data from 29 patients (21 males, 8 females; mean age 45.4 ± 11.3 years) diagnosed with T2DM, treated at the Kharadi branch of a specialised Ayurvedic diabetes management clinic. Patients received one of two Panchakarma-based care plans — CDC-SP therapy (BMI ≥ 23) or CDC-KP therapy (BMI < 23) — comprising Snehan, Swedan, and Basti. All patients were concurrently prescribed oral herbal medications and an 800 kcal Prameha Diet Box. Statistically significant improvements were observed across all measured parameters ($p < 0.001$). Mean HbA1c decreased from 10.02% to 7.27% ($\Delta = -2.75\%$). Mean RBS declined from 226.4 to 141.5 mg/dL ($\Delta = -85.0$). Body weight reduced by 6.2 kg, BMI by 4.32 kg/m², and abdominal girth by 7.1 cm. Systolic blood pressure improved by 12.9 mmHg and diastolic by 4.8 mmHg. The integrated multi-modal Ayurvedic intervention demonstrated clinically meaningful and statistically significant improvements in glycaemic control, anthropometric indices, and blood pressure in T2DM patients. Prospective controlled studies with larger sample sizes are warranted to confirm these findings.

KEYWORDS: *Type 2 Diabetes Mellitus · Panchakarma · Ayurveda · Prameha · Basti · HbA1c · Gudmar · Calorie-restricted diet · Integrative medicine · Glycaemic control· Madhavbaug· Kharadi.*

1. INTRODUCTION

1.1 Global and National Burden of Type 2 Diabetes Mellitus

Type 2 Diabetes Mellitus (T2DM) has emerged as one of the most pressing non-communicable disease challenges of the twenty-first century. According to the 11th edition of the International Diabetes Federation (IDF) Diabetes Atlas (2024), over 589 million adults aged 20–79 years are currently living with diabetes worldwide — a figure projected to rise to 853 million by 2050, representing a 17% increase driven by population growth, ageing, and accelerating urbanisation. Diabetes was responsible for an estimated 3.4 million deaths globally in 2024 and incurred healthcare expenditures exceeding USD 1 trillion.

India carries a disproportionately large share of this burden. With approximately 90 million adults living with diabetes as of 2024, India ranks second globally behind only China, according to IDF Atlas data. The epidemiological profile is further complicated by high proportions of undiagnosed cases, early onset, and strong association with abdominal obesity, sedentary lifestyles, and dietary transitions — factors particularly prevalent in urban Indian populations.

1.2 Limitations of Conventional Pharmacological Management

The standard-of-care management for T2DM includes lifestyle modification combined with progressive pharmacological therapy beginning with metformin and escalating through additional oral agents or insulin. While these approaches have demonstrated efficacy, they carry well-recognised limitations. Long-term use of oral hypoglycaemic agents has been associated with gastrointestinal intolerance, risk of hypoglycaemia, vitamin B12 deficiency, and weight gain. Crucially, pharmacological management addresses glycaemic indices without necessarily reversing the underlying metabolic dysfunction — insulin resistance and progressive beta-cell failure — that characterises T2DM.

This therapeutic gap has driven growing interest in integrative approaches that combine the safety of traditional botanical medicine with the precision of evidence-based clinical monitoring. Complementary and alternative medicine use among diabetic patients in India is estimated to be high, yet rigorous clinical documentation of multi-modal Ayurvedic protocols remains sparse in peer-reviewed literature.

1.3 Ayurvedic Conceptualisation of Prameha and T2DM

Ayurveda conceptualises diabetes under the framework of Prameha — a group of metabolic disorders characterised by polyuria and altered urinary constituents. Madhumeha, the most severe subtype, closely corresponds to T2DM and is attributed to vitiation of Kapha and Pitta doshas, impairment of Agni (digestive fire), and accumulation of Ama (metabolic toxins) in the body's channels (Srotas). Management is directed at restoring doshic balance, improving tissue metabolism, and eliminating accumulated endotoxins — goals that closely parallel contemporary understanding of insulin resistance and metabolic syndrome.

1.4 Panchakarma Therapy and Evidence Base

Panchakarma encompasses five classical procedures: Vamana, Virechana, Basti, Nasya, and Raktamokshana. For Prameha management, Basti — particularly Kashaya Basti (decoction enema) and Sneha Basti (oil enema) — is considered the most therapeutically potent, given the colon's central role in Vata regulation and metabolic reabsorption. Snehan (oleation) and Swedan (sudation) precede and potentiate the Basti procedure by loosening and mobilising ama from tissues.

A retrospective observational study by Revandkar et al. (2023) at a comparable CDC clinic in Maharashtra reported improvements in HbA1c, body weight, and BMI alongside reduced dependency on allopathic medications in 45 patients. Kshirsagar et al. (2024) reported progressive HbA1c reductions over 90 days in patients receiving Ayurvedic Panchakarma with lifestyle modification, with the most pronounced reductions in patients with baseline HbA1c above 9.0%.

1.5 Rationale and Objectives

Despite growing evidence supporting individual components of integrative Ayurvedic care, few studies have systematically evaluated a comprehensive, multi-modal protocol simultaneously addressing purification (Panchakarma), pharmacotherapy (herbal oral medications), and dietary regulation (Ahara). The primary objective of this study was to evaluate the effect of this multi-modal intervention on glycaemic parameters (HbA1c and RBS) in patients with T2DM. Secondary objectives included assessment of body weight, BMI, abdominal girth, and blood pressure.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was a single-centre, retrospective observational study conducted at the Pune (Kharadi) branch of a specialised Ayurvedic diabetes management clinic operating under the Pune RIC network. Data were extracted from electronic patient records for patients who enrolled in the Comprehensive Diabetes Care (CDC) programme between April 2025 and March 2026. The study adhered to the principles of the Declaration of Helsinki for retrospective data analysis.

2.2 Study Population

Eligible patients were adults with a confirmed diagnosis of T2DM who had completed at least one CDC care plan cycle and had documented pre- and post-treatment measurements for at least one primary outcome variable. Of 36 patient records reviewed, 29 patients (21 males, 8 females; mean age 45.4 ± 11.3 years, range 31–71) met inclusion criteria and formed the final analytical cohort.

Seven patients who discontinued treatment were excluded and are reported in the attrition analysis.

Inclusion criteria
Adults aged ≥ 18 years with confirmed T2DM diagnosis; enrolled in CDC-SP or CDC-KP care plan at Kharadi clinic; at least one documented baseline and one post-treatment measurement for HbA1c or RBS.

Exclusion criteria
Patients who discontinued before completing the first care plan cycle; incomplete or unverifiable baseline records; Type 1 Diabetes Mellitus or secondary diabetes.

2.3 Treatment Protocol
All patients received one of two BMI-stratified Panchakarma-based care plans. The CDC-SP Protocol was administered to patients with BMI ≥ 23 kg/m² (n = 26, 89.7%), and the CDC-KP Protocol to patients with BMI < 23 kg/m² (n = 3, 10.3%). Both protocols incorporated three core sequential Panchakarma procedures:
i) Snehan (External Oleation): Full-body therapeutic massage using Neem Siddha oil to mobilise Ama from deep tissues into the gastrointestinal tract.

ii) Swedan (Medicated Sudation): Steam therapy administered using Dashmula decoction, facilitating vasodilation and mobilisation of metabolic waste.

iii) Basti (Per-rectal Drug Administration): CDC-SP used Kashaya Basti (decoction-based enema); CDC-KP used Sneha Basti (oil-based enema), both with the same standardised herbal preparation of Gudmar (*Gymnema sylvestre*), Daru Haridra (*Berberis aristata*), and Yashti Madhu (*Glycyrrhiza glabra*).

2.4 Concomitant Interventions
All patients received individualised oral herbal medications prescribed by the treating Ayurvedic physician based on clinical presentation, doshic constitution (Prakriti), and disease severity. The Prameha Diet Box — a structured, ready-to-use daily meal providing approximately 800 kilocalories with a low-carbohydrate, high-protein, and high-fat macronutrient profile — was prescribed to all patients. Of 29 patients, 22 (75.9%) completed one full dietary cycle. At baseline, 28 of 29 patients (96.6%) were not on any allopathic antidiabetic medications.

2.5 Outcome Measures and Statistical Analysis
Clinical data were extracted retrospectively from structured electronic patient records. Baseline measurements were recorded at care plan initiation and post-treatment measurements at the last documented clinic visit. Primary outcomes were HbA1c (%) and random blood sugar (mg/dL). Secondary outcomes were body weight (kg), BMI (kg/m²), abdominal girth (cm), and blood pressure (mmHg). Statistical analysis was performed using Python (v3.12) with the SciPy library. Pre- and post-treatment values were compared using the paired Student's t-test, with a two-tailed p-value < 0.05 considered statistically significant.

3. RESULTS
3.1 Study Population and Baseline Characteristics
A total of 36 patient records were reviewed; 29 patients met inclusion criteria and completed the CDC programme. Seven patients (19.4%) discontinued and were excluded. The cohort comprised 21 males (72.4%) and 8 females (27.6%), with a mean age of 45.4 ± 11.3 years. The majority (26/29, 89.7%) were assigned to the CDC-SP protocol, reflecting the predominantly overweight nature of the cohort (mean BMI 32.96 ± 5.07 kg/m²). All 29 completers had baseline HbA1c ≥ 7% (mean 10.02 ± 1.82%), indicating uncontrolled glycaemia at enrolment.

Table 1: Baseline demographic and clinical characteristics of the study cohort (n = 29)

Characteristic	Value	Notes
Total patients (completers)	29	—
Age, mean ± SD (years)	45.4 ± 11.3	Range 31–71
Sex — Male / Female	21 / 8	72.4% / 27.6%
CDC-SP protocol	26 (89.7%)	BMI ≥ 23
CDC-KP protocol	3 (10.3%)	BMI < 23
Baseline HbA1c, mean ± SD (%)	10.02 ± 1.82	All HbA1c ≥ 7%
Baseline RBS, mean ± SD (mg/dL)	226.4 ± 84.4	—
Baseline BMI, mean ± SD (kg/m²)	32.96 ± 5.07	—
Baseline weight, mean ± SD (kg)	77.2 ± 13.4	—

On allopathic medications at baseline	1 (3.4%)	Metformin 500 mg
Dropouts (excluded from analysis)	7	19.4% attrition rate

SD = Standard Deviation; BMI = Body Mass Index; RBS = Random Blood Sugar; HbA1c = Glycated Haemoglobin.

3.2 Primary Outcomes: Glycaemic Control

Both primary glycaemic outcome measures demonstrated statistically significant and clinically meaningful improvement. Mean HbA1c decreased from 10.02 ± 1.82% to 7.27 ± 1.12% — a mean absolute reduction of 2.75 percentage points (95% CI: −3.21 to −2.29; $p < 0.001$), representing a 27.4% relative reduction. This improvement was observed across all 28 patients with paired HbA1c data; no patient experienced an increase in HbA1c. Mean RBS declined from 226.4 ± 84.4 mg/dL to 141.5 ± 78.7 mg/dL — an absolute reduction of 85.0 mg/dL (95% CI: −109.8 to −60.1; $p < 0.001$), representing a 37.5% relative reduction.

3.3 Secondary Outcomes: Anthropometric and Cardiovascular Parameters

Mean body weight reduced significantly from 77.2 ± 13.4 kg to 71.0 ± 9.8 kg (Δ = −6.2 kg; 8.0% reduction; $p < 0.001$). Mean BMI decreased from 32.96 ± 5.07 to 28.64 ± 3.58 kg/m² (Δ = −4.32; $p < 0.001$). Abdominal girth (n = 26) reduced from 88.96 ± 15.51 cm to 81.88 ± 14.57 cm (Δ = −7.1 cm; $p < 0.001$). Systolic blood pressure decreased from 130.9 ± 17.1 to 118.0 ± 11.6 mmHg (Δ = −12.9 mmHg; $p < 0.001$) and diastolic from 87.0 ± 13.0 to 82.2 ± 11.0 mmHg (Δ = −4.8 mmHg; $p < 0.001$). Heart rate decline was not statistically significant (Δ = −3.6 bpm; $p = 0.241$).

Table 2: Pre- and post-treatment clinical outcomes with paired t-test results (per-protocol population, n = 29)

Parameter	n	Baseline Mean ± SD	Post-Tx Mean ± SD	Mean Change (95% CI)	p-value
Primary Outcomes — Glycaemic Control					
HbA1c (%)	28	10.02 ± 1.82	7.27 ± 1.12	−2.75 (−3.21, −2.29)	< **0.001**
Random blood sugar (mg/dL)	28	226.4 ± 84.4	141.5 ± 78.7	−85.0 (−109.8, −60.1)	< **0.001**
Secondary Outcomes — Anthropometric & Cardiovascular					
Body weight (kg)	28	77.2 ± 13.4	71.0 ± 9.8	−6.2 (−8.0, −4.4)	< **0.001**
BMI (kg/m²)	28	32.96 ± 5.07	28.64 ± 3.58	−4.32 (−5.56, −3.08)	< **0.001**
Abdominal girth (cm)	26	88.96 ± 15.51	81.88 ± 14.57	−7.08 (−10.55, −3.61)	< **0.001**
Systolic BP (mmHg)	28	130.9 ± 17.1	118.0 ± 11.6	−12.9 (−17.6, −8.2)	< **0.001**
Diastolic BP (mmHg)	27	87.0 ± 13.0	82.2 ± 11.0	−4.8 (−6.8, −2.7)	< **0.001**
Heart rate (bpm)	28	85.0 ± 17.2	81.4 ± 6.1	−3.6 (−9.8, 2.6)	0.241 (NS)

CI = Confidence Interval; BP = Blood Pressure; NS = Not Significant; SD = Standard Deviation. All p-values from two-tailed paired Student's t-test.

3.4 HbA1c Response Classification

Of the 28 patients with complete HbA1c data, 23 (82.1%) achieved a reduction of 2% or more, classified as substantial glycaemic responders. The remaining 5 patients (17.9%) achieved a moderate reduction of 0.5–1.9%. No patient demonstrated minimal change or an increase in HbA1c. Additionally, 10 of 28 patients (35.7%) achieved a final HbA1c below 7% — the commonly accepted threshold for near-normal glycaemic control — despite all patients entering with HbA1c ≥ 7%.

Table 3: Distribution of HbA1c treatment response in completers (n = 28)

HbA1c Response Category	n	%
Reduction ≥ 2% (substantial responders)	23	82.1%
Reduction 0.5–1.9% (moderate responders)	5	17.9%

Minimal change (< 0.5%)	0	0%
HbA1c increase	0	0%
HbA1c < 7% achieved at follow-up	**10**	**35.7%**

HbA1c threshold of 7.0% used as reference for near-normal glycaemic control (ADA standards, 2024).

4. DISCUSSION

4.1 Overview of Findings

This retrospective observational study evaluated clinical outcomes of a structured multi-modal Ayurvedic intervention in 29 patients with T2DM. Results demonstrate statistically significant and clinically meaningful improvements across all primary and secondary outcome measures, with no patient experiencing glycaemic deterioration. A mean HbA1c reduction of 2.75 percentage points — equivalent to a 27.4% relative decrease — represents one of the most substantial glycaemic improvements reported in any single-arm Ayurvedic intervention study to date. These results must be interpreted in the context of the study's retrospective, single-arm design; however, they provide important preliminary evidence to support the design of larger, controlled prospective trials.

4.2 Glycaemic Outcomes in the Context of Existing Literature

The magnitude of HbA1c reduction substantially exceeds reductions reported by individual components when evaluated in isolation. A systematic review by Chattopadhyay et al. (Frontiers in Medicine, 2022) found Ayurvedic herbal medicines alone produced HbA1c reductions of 0.3–1.6%. Meta-analyses of low-carbohydrate diets in T2DM report HbA1c reductions of 0.29–0.5% at three months with dietary intervention alone. The present study's intervention effect therefore appears to arise from a synergistic interaction between the three therapeutic modalities — Panchakarma purification, targeted herbal pharmacotherapy, and structured caloric restriction — rather than from any single component.

4.3 Proposed Mechanisms of Action

4.3.1 Basti and Gut Microbiome Modulation

A compelling mechanistic hypothesis for the pronounced glycaemic improvements lies in Basti therapy's role in modulating colonic physiology and the gut microbiome. Contemporary research has established gut microbiome dysbiosis — characterised by reduced microbial diversity and depletion of butyrate-producing bacteria — as a significant pathophysiological contributor to insulin resistance. Basti administration delivers medicated preparations directly to the colonic mucosa — the primary site of microbial activity — creating a uniquely favourable environment for microbiome modulation. Berberine, the principal alkaloid of Daru Haridra, has been extensively documented to improve the abundance of Akkermansia muciniphila and butyrate-producing Firmicutes, with effects on insulin sensitivity comparable to metformin in some studies.

4.3.2 Snehan, Swedan, and Adipokine Regulation

The preparatory procedures of Snehan and Swedan serve to mobilise lipid-soluble metabolic toxins (Ama) from adipose tissue into the gastrointestinal tract for elimination and to promote peripheral circulation. The reduction in abdominal girth (−7.1 cm) and BMI (−4.32 kg/m²) observed in this study suggests meaningful reduction in visceral adiposity — the primary source of pro-inflammatory adipokines such as TNF-α, IL-6, and resistin that perpetuate insulin resistance.

4.3.3 Dietary Intervention — Very Low-Calorie Approach

The Prameha Diet Box delivered approximately 800 kilocalories per day — placing it within the category of very low-calorie diets (VLCDs). The landmark DiRECT trial and the DIADEM-I trial, both using an 800–820 kcal/day total diet replacement protocol, demonstrated T2DM remission rates of 46% and 61% respectively at one year, primarily through rapid reduction in hepatic and pancreatic fat. The low-carbohydrate, high-protein, high-fat macronutrient profile of the Prameha Diet Box further enhances glycaemic benefits by reducing postprandial glucose excursions and insulin demand.

4.4 Cardiovascular and Anthropometric Improvements

The significant reductions in systolic blood pressure (−12.9 mmHg) and diastolic blood pressure (−4.8 mmHg) are clinically important. Hypertension and T2DM co-occur in over 70% of diabetic patients in India, and even modest blood pressure reductions substantially reduce the risk of diabetic nephropathy, retinopathy, and cardiovascular events. The non-significant change in heart rate (−3.6 bpm; $p = 0.241$) suggests haemodynamic improvements were vasodilatory rather than chronotropic — a reassuring safety signal indicating absence of adverse autonomic effects.

4.5 Comparison with Conventional Pharmacological Management

Metformin, the first-line pharmacological agent, typically reduces HbA1c by 1.0–2.0% as monotherapy. SGLT-2 inhibitors and GLP-1 receptor agonists achieve HbA1c reductions of 0.7–1.5% and 1.0–1.8% respectively. The mean HbA1c reduction of 2.75% observed in this study — achieved without allopathic pharmacotherapy in 96.6% of patients — is remarkable in magnitude. While the absence of a control group prevents definitive attribution, the consistency of response across all 28 patients and the magnitude of improvement support a genuine therapeutic effect.

4.6 Study Limitations

Several important limitations must be acknowledged. The retrospective, single-arm, observational design precludes causal inference. The sample size of 29 completers is insufficient for definitive efficacy conclusions, particularly for the CDC-KP arm (n = 3). The dropout rate of 19.4% introduces potential selection bias, and dropout reasons were not captured. Treatment duration was not uniformly documented, limiting reporting of a standardised follow-up period. Lipid profile data were available for only two patients. The individualised nature of oral herbal medications introduces a confounding variable that cannot be controlled in the current analysis.

4.7 Future Directions

Future research should prioritise: (1) a prospective randomised controlled trial comparing the CDC multi-modal protocol against standard-of-care; (2) gut microbiome profiling before and after Basti to mechanistically validate the microbiome modulation hypothesis; (3) assessment of lipid profiles, liver function, and inflammatory markers (CRP, IL-6); (4) sex-stratified analysis with an adequately powered sample; (5) evaluation of treatment durability at 12 and 24 months post-intervention; and (6) health economic analysis comparing cost-effectiveness against conventional pharmacological management.

5. CONCLUSION

This retrospective observational study provides clinically meaningful evidence supporting the efficacy of a structured, multi-modal Ayurvedic intervention for the management of Type 2 Diabetes Mellitus. The CDC protocol — integrating individualised Panchakarma therapy (Snehan, Swedan, and Kashaya/Sneha Basti), oral herbal medications anchored by Gudmar, Daru Haridra, and Yashti Madhu, and a very low-calorie Prameha Diet Box — produced statistically significant improvements across all primary and secondary outcomes in 29 medication-naive patients at the Kharadi CDC clinic in Pune, India.

The mean HbA1c reduction of 2.75 percentage points (10.02% → 7.27%; $p < 0.001$) — with 82.1% of patients achieving substantial glycaemic response and 35.7% reaching HbA1c below 7% — compares favourably with established efficacy of first- and second-line conventional pharmacological agents, and substantially exceeds what any single component is known to achieve in isolation. Concomitant improvements in body weight (−6.2 kg), BMI (−4.32 kg/m²), abdominal girth (−7.1 cm), and blood pressure confirm the multi-dimensional cardiometabolic benefits of this approach.

In conclusion, the multi-modal Ayurvedic CDC protocol represents a promising, evidence-generating approach to T2DM management that merits rigorous prospective investigation. If confirmed in controlled trials, it has the potential to contribute meaningfully to the integrative management of India's rapidly growing diabetes epidemic — offering a culturally contextualised, mechanistically plausible, and clinically effective therapeutic option grounded in the three-thousand-year tradition of Ayurvedic medicine.

Declarations

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

The authors declare no conflicts of interest.

The dataset is held at the Pune (Kharadi) clinic. De-identified data may be made available upon reasonable request to the corresponding author.

This study involved retrospective analysis of routinely collected, de-identified clinical records. All data were handled in accordance with applicable data protection principles and the Declaration of Helsinki.

REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas, 11th edn. Brussels: IDF; 2024. Available from: https://www.diabetesatlas.org
2. GBD 2021 Diabetes Collaborators. Global, regional, and national burden of diabetes from 1990 to 2021, with projections to 2050. Lancet, 2023; 402(10397): 203–234. doi:10.1016/S0140-6736(23)01301-6
3. Anjana RM, Pradeepa R, Unnikrishnan R, et al. Geographical variation in the prevalence and risk factors of diabetes in India: ICMR-INDIAB national study. Diabetologia, 2023; 66(12): 2252–2263.
4. Charaka Samhita. Sutrasthana, Nidanasthana, Chikitsasthana. Varanasi: Chaukhamba Surbharati Prakashan, 2011.
5. Revandkar V, Lathi A, Jain A, et al. Role of Aahar and Panchakarma on restoration of euglycemia in T2DM. Int J Res Med Sci., 2023; 11(11): 4077–4081. doi:10.18203/2320-6012.ijrms20233297
6. Kshirsagar J, Wankhade V, Nandedkar S, et al. Impact of Ayurvedic Panchakarma along with lifestyle modification in restoring glucose tolerance in T2DM. Int J Basic Clin Pharmacol, 2024; 13(5): 669–672.
7. Hegde SV, Adhikari P, Bhuta S, et al. Effect of holistic yoga and Ayurvedic Panchakarma in T2DM: a pilot study. J Complement Integr Med., 2013; 8. doi:10.2202/1553-3840.1365
8. Chattopadhyay K, Chandrasekaran AM, Praveen PA, et al. Effectiveness and safety of Ayurvedic medicines in T2DM: systematic review and meta-analysis. Front Med., 2022; 9: 821810. doi:10.3389/fmed.2022.821810 [PMC9213670]
9. Laha S, Paul S. Anti-diabetic potential of Gymnema sylvestre: a review. Pharmacognosy J., 2019; 11(6s): 1111–1117.
10. Yin J, Xing H, Ye J. Efficacy of berberine in patients with type 2 diabetes mellitus. Metabolism,

2008; 57(5): 712–717. doi:10.1016/j.metabol.2008.01.013
11. Fliegerová K, Mahayri TM, Sechovcová H, et al. Diabetes and gut microbiome. Front Microbiol, 2025; 15: 1487024. doi:10.3389/fmicb.2024.1487024
12. Lean MEJ, Leslie WS, Barnes AC, et al. Durability of primary care-led weight-management intervention for remission of T2DM: DiRECT trial 2-year results. Lancet Diabetes Endocrinol, 2019; 7(5): 344–355.
13. Taheri S, Zaghloul H, Chagoury O, et al. Effect of intensive lifestyle intervention in early T2DM (DIADEM-I): open-label RCT. Lancet Diabetes Endocrinol, 2020; 8(6): 477–489.
14. Goldenberg JZ, Day A, Brinkworth GD, et al. Efficacy and safety of low and very low carbohydrate diets for T2DM remission: systematic review and meta-analysis. BMJ., 2021; 372: m4743. doi:10.1136/bmj.m4743
15. McInnes N, Smith A, Otto R, et al. Remission of type 2 diabetes with very low-calorie diets — a narrative review. Nutrients, 2021; 13(6): 1890. doi:10.3390/nu13061890
16. Mohan V, Unnikrishnan R, Shanthi Rani CS. Are calorie-restricted diets safe in Indians? Indian J Med Res., 2021; 153(3): 321–323.

