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Research article

Effect of Integrative Ayurvedic Intervention (CDC Panchakarma Protocol with Low-Calorie Prameha Diet) on Glycemic Control and Cardiometabolic Parameters in Type 2 Diabetes: A Pre-Post Observational Study

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ABSTRACT

Background

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder with a rapidly increasing prevalence in India. While pharmacological management achieves symptomatic control, it does not address the underlying metabolic dysregulation. Ayurvedic medicine offers a holistic approach through Panchakarma therapies, dietary modification, and herbal medications. The CDC (Complete Diabetes Care) protocol is a structured integrative intervention combining classical Panchakarma — Snehan (oleation), Swedan (sudation), and Basti (per-rectal herbal drug administration) — with an 800-calorie, carbohydrate-restricted Prameha diet and individualized oral herbal formulations.

Objectives

To evaluate the effect of the CDC integrative Ayurvedic protocol on glycemic indices, anthropometric parameters, and cardiometabolic parameters in patients with Type 2 diabetes mellitus.

Methods

A pre-post observational study was conducted at two Ayurvedic clinics in Pune, Maharashtra, India, enrolling 32 patients with T2DM. Patients received individualized CDC Panchakarma (CDC-SP for BMI ≥ 23, n=31; CDC-KP for BMI < 23, n=1), the Prameha diet box, and oral herbal medications. Outcome parameters — HbA1c, random blood sugar (RBS), body weight, BMI, abdominal girth, systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate — were recorded at baseline and end of treatment. Paired t-tests were used for statistical analysis; $p < 0.05$ was considered significant.

Results

Significant improvements were observed in all primary parameters. HbA1c decreased from 9.39 ± 1.79% to 7.76 ± 1.53% (Δ −1.64%, $p < 0.001$) and RBS from 258.75 ± 109.35 to 160.03 ± 50.09 mg/dL (Δ −98.72 mg/dL, −31.8%; $p < 0.001$). At end of treatment, 37.5% of patients achieved HbA1c < 7.0% and 65.6% achieved HbA1c < 8.0%. Significant reductions were also noted in body weight (−3.07 kg; $p < 0.001$), BMI (−1.14 kg/m²; $p < 0.001$), abdominal girth (−4.90 cm; $p < 0.001$), SBP (−13.12 mmHg; $p < 0.001$), DBP (−5.47 mmHg; $p = 0.005$), and heart rate (−5.28 bpm; $p = 0.001$).

Conclusion

The CDC integrative Ayurvedic protocol demonstrated statistically significant and clinically meaningful improvements in glycemic control and cardiometabolic parameters in T2DM patients. These findings support further investigation through randomized controlled trials with larger cohorts and longer follow-up periods.

1. INTRODUCTION

Diabetes mellitus is one of the most prevalent non-communicable diseases globally, with India bearing one of the largest disease burdens. According to the International Diabetes Federation, India had approximately 101 million people living with diabetes in 2021, a figure projected to exceed 124 million by 2045 [1]. Type 2 diabetes mellitus (T2DM), which constitutes over 90% of all diabetes cases, is characterized by insulin resistance, progressive beta-cell dysfunction, and chronic hyperglycemia, resulting in serious macrovascular and microvascular complications [2].

Standard pharmacological treatment with oral hypoglycemic agents and insulin analogues has been the cornerstone of T2DM management. However, these approaches are associated with side effects, long-term dependency, and failure to address the metabolic root causes of the disease [3]. This has driven increasing interest in integrative and complementary approaches, particularly those rooted in traditional medicine systems with established safety profiles.

Ayurveda, India's ancient system of medicine, conceptualizes diabetes under the term Prameha — a group of urinary disorders involving metabolic derangement. The Ayurvedic framework addresses T2DM through multi-modal interventions targeting Kapha and Pitta imbalances, tissue nutrition, and metabolic fire (Agni). Classical

Panchakarma therapies — specifically Snehan (medicated oleation), Swedan (therapeutic sudation), and Basti (per-rectal drug administration) — form the cornerstone of Ayurvedic detoxification and metabolic correction in diabetes management [4,5].

The CDC (Complete Diabetes Care) protocol, developed and implemented at our clinics, integrates three Panchakarma components with a structured low-calorie diet and individualized oral herbal formulations. The CDC-SP variant (for BMI ≥ 23) employs a Kwath-based (decoction) Basti using Gudmar (Gymnema sylvestre), Daruharidra (Berberis aristata), and Yashtimadhu (Glycyrrhiza glabra), while the CDC-KP variant (for BMI < 23) uses an oil-based Basti with the same herbs. The dietary component — the Prameha diet box — provides approximately 800 kcal/day with reduced carbohydrates and enhanced protein and fat content, administered as a ready-to-use meal. This multi-pronged approach targets insulin sensitization, gut microbiome modulation, visceral fat reduction, and pancreatic beta-cell support through mechanisms reported in contemporary research on constituent herbs [6,7,8].

Despite its clinical use, robust observational data supporting the CDC protocol remain limited. The present study aimed to evaluate its effect on glycemic control (HbA1c, RBS), anthropometric parameters (body weight, BMI, abdominal girth), and cardiometabolic markers (blood pressure, heart rate) in T2DM patients treated across two Ayurvedic clinics in Pune, Maharashtra.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was a prospective pre-post observational study conducted at two Ayurvedic clinical centers in Pune, Maharashtra, India: Ambegaon Budruk (n=26 patients) and Loni Kalbhor (n=6 patients). Data were collected from patients who underwent the CDC protocol for T2DM management. As a retrospective analysis of existing clinical records, formal ethics committee approval was not obtained; however, all data were de-identified and used in accordance with standard data privacy practices. Informed consent was obtained from patients as part of routine clinical care.

2.2 Patient Selection

Patients were included if they had a confirmed diagnosis of Type 2 diabetes mellitus (based on HbA1c ≥ 6.5% or documented physician diagnosis), were 18 years of age or older, and had completed at least one cycle of the CDC Panchakarma protocol with both baseline and follow-up measurements available. Patients with Type 1 diabetes, gestational diabetes, severe renal or hepatic disease, or incomplete records were excluded.

2.3 Intervention

CDC Panchakarma Protocol: The CDC protocol consists of three classical Panchakarma procedures administered in sequence:

(i) **Snehan** (medicated oleation): External application of Neem Siddha oil to the body, promoting lipid mobilization and skin absorption of active phytoconstituents with anti-diabetic properties.

(ii) **Swedan** (therapeutic sudation): Steam treatment using Dashmukada decoction to facilitate peripheral circulation, enhance insulin sensitivity, and promote elimination of metabolic waste products.

(iii) **Basti** (per-rectal drug administration): In CDC-SP therapy (BMI ≥ 23), a Kwath-based (decoction) Basti was prepared using Gudmar (Gymnema sylvestre), Daruharidra (Berberis aristata), and Yashtimadhu (Glycyrrhiza glabra). In CDC-KP therapy (BMI < 23), an oil-based Basti with the same herb combination was used. Basti acts on the colon and is considered the most effective Panchakarma for metabolic disorders in Ayurvedic literature [4].

Prameha Diet Box: All patients were prescribed the Prameha diet box, a ready-to-use meal providing approximately 800 kcal/day. The diet is low in carbohydrates, high in protein and dietary fat, designed to reduce postprandial glucose excursions and support ketogenic metabolism. The mean number of diet box courses completed per patient was 2.0 (range: 0–6).

Oral Herbal Medications: Individualized oral Ayurvedic herbal formulations were prescribed alongside Panchakarma based on each patient's constitution (Prakriti), disease severity, and comorbidities. The specific formulations varied between patients and are not standardized across the cohort; this is noted as a limitation of the study.

Allopathic Medications: Patients who were already on allopathic anti-diabetic medications (n=20, 62.5%) were permitted to continue these medications during the intervention. Medication reduction was considered only in patients demonstrating sustained glycemic improvement, under physician supervision.

2.4 Outcome Measures

The following parameters were recorded at baseline (prior to first Panchakarma session) and at the end of treatment:

• **Glycemic parameters:** HbA1c (%), random blood sugar (RBS, mg/dL)

• **Anthropometric parameters:** Body weight (kg), BMI (kg/m²), abdominal girth (cm)

• **Cardiometabolic parameters:** Systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg), heart rate (bpm)

The number of Panchakarma sessions (DonePK) was recorded per patient. Treatment duration varied based on individual care plan levels (CDC SP Base, CDC SP 1, CDC SP 2, CDC SP 3, CDC KP 2), clinical response, and patient compliance.

2.5 Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Python (SciPy library, v1.11). Continuous variables are expressed as mean ± standard deviation (SD). Paired t-tests were used to compare pre- and post-treatment values. Ninety-five percent confidence intervals (95% CI) are reported for mean differences. Statistical significance was set at $p < 0.05$. Two-tailed tests were used throughout. Values marked *** indicate $p < 0.001$; ** indicate $p < 0.01$.

3. RESULTS

3.1 Patient Demographics

A total of 32 patients with T2DM were included in the study. The cohort comprised 24 males (75%) and 8 females (25%), with a mean age of 47.3 ± 11.2 years (range: 28–69 years). The largest age group was those under 40 years (n=13, 40.6%), followed by the 50–60 year group (n=10, 31.3%). Baseline characteristics are summarized in Table 1.

Table 1. Baseline patient characteristics (n=32)

Characteristic	Value	Range / Category
Total patients	32	—
Male / Female	24 (75%) / 8 (25%)	—
Mean age (years)	47.3 ± 11.2	28–69 years

Characteristic	Value	Range / Category
Age < 40 years	13 (40.6%)	—
Age 40–50 years	5 (15.6%)	—
Age 50–60 years	10 (31.3%)	—
Age > 60 years	4 (12.5%)	—
Mean baseline BMI (kg/m²)	27.14 ± 3.58	21.2–33.3
CDC-SP (BMI ≥ 23)	31 (96.9%)	—
CDC-KP (BMI < 23)	1 (3.1%)	—
On allopathic medications	20 (62.5%)	—
Mean Panchakarma sessions	9.4 ± 5.4	1–18 sessions
Study sites	2 clinics	Ambegaon Budruk (n=26), Loni Kalbhor (n=6)

3.2 Treatment Delivery

The mean number of Panchakarma sessions administered was 9.4 ± 5.4 per patient (range: 1–18 sessions). The majority of patients received the CDC-SP 3 plan (n=17, 53.1%), followed by CDC SP Base (n=7, 21.9%), CDC SP 2 (n=5, 15.6%), CDC SP 1 (n=2, 6.3%), and CDC KP 2 (n=1, 3.1%). The mean number of Prameha diet box courses completed was 2.0 per patient (range: 0–6).

3.3 Primary Outcome: Glycemic Control

HbA1c showed a statistically significant reduction from a mean of 9.39 ± 1.79% at baseline to 7.76 ± 1.53% at end of treatment (mean change: −1.64%, 95% CI: −2.28 to −1.00; $p < 0.001$). This represents a 15.9% relative reduction in HbA1c. At baseline, 8 patients (25%) had HbA1c > 10%, reflecting poorly controlled diabetes; 22 patients (68.8%) had HbA1c between 7–10%, and 2 patients (6.3%) had HbA1c < 7%.

At end of treatment, 12 patients (37.5%) achieved HbA1c < 7.0% (near-normal glycemic control) and 21 patients (65.6%) achieved HbA1c < 8.0% (good diabetic control per ADA guidelines). RBS decreased significantly from 258.75 ± 109.35 mg/dL to 160.03 ± 50.09 mg/dL (mean change: −98.72 mg/dL, 95% CI: −132.53 to −64.90; $p < 0.001$), representing a 31.8% reduction.

3.4 Anthropometric Outcomes

Significant reductions were observed in all anthropometric parameters. Mean body weight decreased by 3.07 kg (−4.2%; $p < 0.001$). BMI reduced from 27.14 ± 3.58 to 26.00 ± 3.81 kg/m² (mean change: −1.14 kg/m²; $p < 0.001$).

Notably, abdominal girth showed a clinically important reduction of 4.90 cm (from 101.35 ± 10.62 to 96.45 ± 11.02 cm; $p < 0.001$), reflecting a significant decrease in central adiposity.

3.5 Cardiometabolic Outcomes

Systolic blood pressure showed one of the largest proportional improvements, falling from 132.06 ± 16.09 mmHg to 118.94 ± 12.09 mmHg (mean change: −13.12 mmHg, −9.2%; $p < 0.001$). Diastolic blood pressure decreased from 86.09 ± 11.10 to 80.62 ± 8.26 mmHg (mean change: −5.47 mmHg; $p = 0.005$). Heart rate reduced from 87.50 ± 12.20 to 82.22 ± 10.65 bpm (mean change: −5.28 bpm; $p = 0.001$).

3.6 Allopathic Medication Status

At baseline, 20 patients (62.5%) were on allopathic anti-diabetic and/or antihypertensive medications including metformin, sulfonylurea combinations, DPP-4 inhibitors, SGLT-2 inhibitors, and statins. Of these, 3 patients (9.4%) achieved documented partial reduction in allopathic medications (reduction percentages: 60%, 33%, and 33% respectively) following sustained glycemic improvement under the CDC protocol, under physician supervision.

Table 2. Pre- and post-treatment outcome parameters (n=32)

Parameter	Baseline (Mean ± SD)	Post-treatment (Mean ± SD)	Mean Change (%)	p-value
HbA1c (%)	9.39 ± 1.79	7.76 ± 1.53	−1.64 (−15.9%)	<0.001***
RBS (mg/dL)	258.75 ± 109.35	160.03 ± 50.09	−98.72 (−31.8%)	<0.001***
Body weight (kg)	76.08 ± 12.13	73.02 ± 12.68	−3.07 (−4.2%)	<0.001***
BMI (kg/m²)	27.14 ± 3.58	26.00 ± 3.81	−1.14 (−4.3%)	<0.001***
Abdominal girth (cm)	101.35 ± 10.62	96.45 ± 11.02	−4.90 (−4.8%)	<0.001***
SBP (mmHg)	132.06 ± 16.09	118.94 ± 12.09	−13.12 (−9.2%)	<0.001***
DBP (mmHg)	86.09 ± 11.10	80.62 ± 8.26	−5.47 (−5.4%)	0.005**
Heart rate (bpm)	87.50 ± 12.20	82.22 ± 10.65	−5.28 (−5.5%)	0.001***

Table footnote: Values are mean +/- SD. Paired t-test. CI reported in text.

4. DISCUSSION

This pre-post observational study demonstrated that the CDC integrative Ayurvedic protocol produced statistically significant and clinically meaningful improvements in glycemic control, body composition, and cardiometabolic parameters in patients with Type 2 diabetes mellitus. To our knowledge, this is among the first structured analyses of the CDC protocol combining Panchakarma, a formulated low-calorie Ayurvedic diet, and individualized herbal medications in a real-world clinical setting.

The 1.64 percentage point reduction in HbA1c is clinically significant. For context, the UKPDS demonstrated that each 1% reduction in HbA1c is associated with a 21% reduction in diabetes-related deaths and a 37% reduction in microvascular complications [9]. Achieving HbA1c < 7.0% in 37.5% of patients — many of whom had baseline HbA1c in the 8–10% range — is a meaningful outcome, particularly as these patients were not subject to intensification of allopathic therapy. The concurrent 31.8% reduction in RBS further corroborates improvement in day-to-day glucose regulation.

The glycemic benefits of the individual components of the CDC protocol are supported by existing phytochemical and mechanistic research. Gymnema sylvestre (Gudmar) has demonstrated insulin secretagogue and insulin sensitizing properties, with gymnemic acids shown to suppress intestinal glucose absorption and promote pancreatic beta-cell regeneration [6]. Berberis aristata (Daruharidra) contains berberine, which activates AMPK — a central mediator of glucose and lipid metabolism — mimicking some effects of metformin [7]. Glycyrrhiza glabra (Yashtimadhu) has demonstrated anti-inflammatory, adaptogenic, and mild insulin-sensitizing properties [8]. Basti, the per-rectal route, is hypothesized to allow direct absorption of these active constituents into the portal circulation, potentially amplifying hepatic and colonic metabolic effects.

The 800-calorie Prameha diet box, with its low-carbohydrate and high-fat profile, likely contributes significantly to glycemic improvement through multiple mechanisms: caloric restriction promotes weight loss and visceral fat reduction, while carbohydrate restriction directly reduces postprandial glucose excursions and HbA1c [10]. The observed 4.2% reduction in body weight and 4.8% reduction in abdominal girth align with benefits expected from a low-calorie diet intervention, and are independently associated with improvements in insulin sensitivity.

The significant reductions in blood pressure (SBP −13.12 mmHg, DBP −5.47 mmHg) are of clinical importance given the high prevalence of hypertension in T2DM patients and its role in cardiovascular risk. Weight loss, reduced sympathetic activation, and anti-inflammatory effects of the herbal components may all contribute to this outcome. The reduction in resting heart rate (−5.28 bpm) is an additional cardiometabolic benefit, potentially reflecting improved autonomic tone and reduced sympathetic overdrive.

Snehan and Swedan, the preparatory Panchakarma steps, serve as both therapeutic and potentiating procedures — Snehan through transdermal delivery of bioactive lipophilic compounds in Neem Siddha oil, and Swedan through enhancement of peripheral circulation and facilitation of tissue-level metabolic activity. Neem (Azadirachta indica) has well-documented hypoglycemic and anti-inflammatory properties [11], and its Siddha preparation may offer synergistic benefits.

4.1 Limitations

This study has several limitations that should be acknowledged. First, the absence of a control group limits causal inference; improvements may be partially attributable to regression to the mean, dietary compliance, or lifestyle modification independent of Panchakarma.

Second, the sample size of 32 patients, while sufficient for detecting the large effect sizes observed, is small for subgroup analyses. Third, oral herbal medications were individualized and not standardized across patients, introducing heterogeneity in the intervention. Fourth, lipid profile data (cholesterol, triglycerides, HDL, LDL) were available for only 8 patients, precluding analysis of the lipid-lowering potential of the protocol. Fifth, formal ethics committee approval was not obtained for this retrospective analysis. Finally, treatment duration varied across patients, making it difficult to attribute outcomes to a fixed time point. Future studies should include randomized controlled designs, standardized herbal protocols, longer follow-up, and comprehensive lipid and inflammatory marker assessment.

5. CONCLUSION

The CDC integrative Ayurvedic protocol — comprising Panchakarma (Snehan, Swedan, and Basti with Gudmar, Daruharidra, and Yashtimadhu), the structured Prameha low-calorie diet, and individualized oral herbal medications — produced statistically significant and clinically meaningful improvements in HbA1c, random blood sugar, body weight, BMI, abdominal girth, blood pressure, and heart rate in 32 patients with Type 2 diabetes mellitus. These findings establish a strong preliminary evidence base for the CDC protocol as an effective integrative management strategy in T2DM. Randomized controlled trials with larger, diverse cohorts, standardized protocols, longer follow-up, and comprehensive biomarker profiling are warranted to confirm and extend these results.

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