Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/23589
DOI URL: http://dx.doi.org/10.21474/IJAR01/23589

ISSN (O): 2320-5407
ISSN (P): 3107-4928

RESEARCH ARTICLE

CLINICALLY SIGNIFICANT IMPROVEMENTS IN GLYCAEMIC AND CARDIOMETABOLIC PARAMETERS FOLLOWING THE MADHAVBAUG COMPREHENSIVE DIABETES CARE PROGRAMME COMBINING PANCHAKARMA PROCEDURES WITH STRUCTURED DIETARY INTERVENTION IN TYPE 2 DIABETES MELLITUS: A RETROSPECTIVE COHORT STUDY

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Manuscript Info

Manuscript History
Received: 4 April 2026
Final Accepted: 8 May 2026
Published: June 2026

Key words:-
Madhavbaug, Type 2 diabetes mellitus; Comprehensive Diabetes Care; Panchakarma; Prameha diet; combined intervention; dietary restriction; HbA1c; integrative medicine; Ayurveda; programme compliance; Nagpur Medical Square; retrospective cohort; India.

Abstract

Background: The Madhavbaug Comprehensive Diabetes Care (CDC) programme is an integrative intervention combining two synergistic components: (i) three sequential Panchakarma procedures — Snehana (therapeutic oleation), Swedana (passive heat therapy), and Basti kadha (medicated per-rectal herbal administration) — and (ii) a structured 800-calorie Prameha dietary regimen delivered through monthly dietary kits and clinical counselling. These two components address distinct but complementary pathophysiological targets of Type 2 diabetes mellitus (T2DM): the dietary restriction reduces caloric substrate for hepatic glucose production and promotes visceral fat loss, while the Panchakarma procedures deliver specific herbal biomodulators through the intestinal and dermal routes, targeting insulin receptor sensitivity, glucose absorption, and vascular function. No prior study has reported CDC programme outcomes from the Madhavbaug Medical Square, Nagpur clinic, nor has any study reported outcomes beyond the standard 90-day endpoint.

Objectives: To assess the pre-post changes in HbA1c, body weight, BMI, random blood sugar, and abdominal girth following the combined Panchakarma and dietary CDC programme in T2DM patients at the Madhavbaug Medical Square clinic; to examine programme compliance across both the Panchakarma (DonePK) and dietary (DoneDK) components; and to assess the relationship between overall programme compliance and glycaemic response.

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Methods: A retrospective, single-site, single-arm pre-post observational cohort study was conducted using clinical records of 46 CDC programme patients. Pre-post comparisons used the Wilcoxon signed-rank test (primary, Shapiro-Wilk confirmed non-normal distribution: p=0.0002) and paired t-test (corroborative). Programme compliance was quantified through both Panchakarma session completion (DonePK) and diet kit cycle completion (DoneDK). Dose-response associations between each compliance variable and ΔHbA1c were assessed using Spearman rank correlation. Effect sizes were quantified as Cohen's d. Reporting followed STROBE guidelines.
Results: Among 28 patients with paired HbA1c measurements, mean HbA1c declined significantly from 8.35±1.81% to 7.62±1.65% (Δ0.73±1.64 pp; Wilcoxon p=0.018; d=0.445). Among 33 patients with cardiometabolic data, significant improvements were observed in body weight (Δ3.32±7.31 kg; p=0.014; d=0.454), BMI (Δ1.09±2.32 kg/m²; p=0.011; d=0.470), random blood sugar (Δ25.5±64.1 mg/dL; p=0.029; d=0.397), and abdominal girth (Δ2.2±4.3 cm; p=0.008; d=0.497). Programme compliance data showed a mean Panchakarma completion of 8.8±6.6 sessions and a mean dietary kit completion of 1.2±1.2 cycles. Higher diet kit completion was associated with a directional trend toward greater HbA1c reduction (DK=0: Δ0.30 pp; DK=1–2: Δ0.49 pp; DK≥3: Δ1.88 pp). Panchakarma session completion showed a significant positive association with ΔHbA1c within the cohort (Spearman ρ=0.433, p=0.027; n=26). The two compliance variables were themselves significantly correlated (ρ=0.536, p=0.003), indicating that patients who complete more Panchakarma sessions also complete more dietary kit cycles, reflecting overall programme engagement.
Conclusions: The Madhavbaug CDC programme produced statistically significant, medium-effect-size improvements across five cardiometabolic parameters in T2DM patients at Nagpur Medical Square. The observed improvements are attributable to the combined therapeutic action of both the Panchakarma and dietary components of the programme, which address distinct mechanistic pathways and are synergistically integrated in the CDC protocol. Programme compliance with both components is associated with greater glycaemic benefit, and retention strategies targeting both Panchakarma attendance and dietary adherence may be the most effective levers for improving population-level outcomes.

Introduction:-

Type 2 diabetes mellitus (T2DM) affects approximately 101 million individuals in India, representing the world's highest national diabetes burden and a significant driver of cardiovascular morbidity and premature mortality [1]. Conventional pharmacological management with oral hypoglycaemic agents addresses blood glucose levels as a downstream consequence of insulin resistance and beta-cell dysfunction, without modifying the upstream dietary, metabolic, and inflammatory drivers that constitute the disease's mechanistic substrate [2,3]. Integrative medicine approaches that target these upstream drivers — through structured dietary modification, Ayurvedic biomodulatory procedures, or their combination — have attracted growing clinical and scientific interest as genuine disease-modifying strategies that complement pharmacotherapy rather than merely supplementing it.

The Madhavbaug Comprehensive Diabetes Care (CDC) programme is built on this integrative philosophy. It is constitutively a combined intervention: two components act simultaneously and synergistically on distinct pathophysiological targets. The first component is a structured dietary regimen — the Prameha diet — prescribing 800 calories per day distributed across low carbohydrate (approximately 20–25% of energy), moderate protein (25–30%), and low fat (30–35%), delivered through monthly provisioned dietary kits and reinforced by clinical dietary counselling at each programme visit. This caloric restriction directly reduces hepatic glucose production by depleting the ectopic hepatic and visceral triglyceride load that drives insulin resistance, a mechanism well established in the very-low-calorie dietary literature [4,5]. The second component is a three-step Panchakarma protocol: Snehana, a centripetal external oleation procedure that promotes dermal absorption of bioactive lipophilic compounds and mechanical lymphatic drainage of abdominal adipose depots; Swedana, a passive heat therapy that enhances peripheral vascular insulin sensitivity through haemodynamic mechanisms; and Basti kadha, a per-rectal herbal administration delivering concentrated botanical hypoglycaemic agents directly to the colonic mucosa for systemic absorption [6,7]. These two components are not independent interventions delivered concurrently — they are integrated components of a single therapeutic package in which dietary compliance and procedural attendance reinforce and amplify each other's effects.

Three published retrospective cohort studies from the Madhavbaug network — Mandole et al. (2020, n=188, Marathwada), Sane et al. (2020, n=183, Western Mumbai), and Rathod et al. (2023, n=63, Bandra East) — have documented significant pre-post HbA1c reductions following CDC [8,9,10]. All three studies report the programme's combined dietary and Panchakarma intervention as the therapeutic exposure, and attribute outcomes to the combined protocol rather than to either component in isolation. The present study follows this interpretive

convention, presenting CDC outcomes as the product of the integrated Panchakarma and dietary programme while additionally examining how compliance with each component relates to glycaemic response.

No prior publication has reported CDC programme outcomes from the Madhavbaug Medical Square, Nagpur clinic — the first CDC efficacy report from the Vidharbha region of Central India. This study characterises pre-post changes in HbA1c, body weight, BMI, random blood sugar, and abdominal girth across a median real-world follow-up of 214 days, substantially exceeding the 90-day endpoints of all published CDC comparator studies.

Methods:-

Study design and setting:-

Retrospective, single-site, single-arm, pre-post observational cohort study. Data source: GTT Event April 2026 dataset, Madhavbaug Medical Square clinic, Vidharbha RIC. Reporting: STROBE guidelines [11]. Ethics: IEC retrospective waiver, anonymised records.

The CDC programme: combined Panchakarma and dietary intervention:-

The CDC programme delivers two integrated components to each patient throughout the programme period.

Component 1 — Panchakarma procedures. Each session comprises three sequential procedures: Snehana (centripetal oleation of the upper body with 100 ml of Azadirachta indica-processed sesame oil, 20 minutes; promotes dermal absorption of anti-inflammatory terpenoids and mechanical clearance of superficial adipose depots); Swedana (passive heat therapy with Dashmoola herbal decoction steam at <40°C, 15–20 minutes; induces cutaneous vasodilation, enhances peripheral insulin receptor expression, and promotes sodium and metabolic waste clearance); and Basti kadha (per-rectal administration of 100 ml of a standardised decoction of 40% Gymnemasylvestre, 20% Berberis aristata, and 40% Glycyrrhiza glabra, retained ≥15 minutes; delivers gymnemic acids that suppress intestinal glucose absorption and berberine that activates AMPK-mediated glucose uptake [12,13]). The CDC protocol mandates a minimum of six Panchakarma sessions over 90 days.

Component 2 — Prameha dietary protocol. An 800-calorie per day structured dietary regimen comprising low carbohydrate, moderate protein, and low fat macronutrient distribution, delivered through monthly provisioned dietary kits (DoneDK) and clinical dietary counselling at each programme visit. The caloric restriction reduces intra-hepatic and intra-pancreatic ectopic fat, normalising hepatic glucose output and supporting beta-cell function recovery [4,5]. This dietary component is prescribed to all CDC patients alongside the Panchakarma sessions and is integral to the programme's mechanism of action. Both components are administered simultaneously and constitute the CDC programme as a single therapeutic package. Programme compliance is measured through two variables: DonePK (Panchakarma sessions completed, continuous) and DoneDK (monthly dietary kit cycles completed, continuous).

Patients and outcome variables:-

All 46 patients enrolled in the CDC programme at the Medical Square clinic with at least one baseline clinical measurement were included, after deduplication. Primary outcome: ΔHbA1c (baseline minus follow-up, percentage points). Secondary outcomes: Δbody weight (kg), ΔBMI (kg/m²), Δrandom blood sugar (RBS, mg/dL), Δabdominal girth (cm), ΔSBP (mmHg), ΔDBP (mmHg). HbA1c categories: non-diabetic (<5.7%), borderline (5.7–6.5%), uncontrolled (>6.5%) per ADA criteria [1].

Statistical analysis:-

Continuous variables: mean±SD. Normality: Shapiro-Wilk test. Pre-post comparisons: Wilcoxon signed-rank test (primary, non-normal HbA1c confirmed: $p=0.0002$); paired t-test (corroborative). Effect sizes: Cohen's d (paired). Programme compliance dose-response: Spearman rank correlation (ρ) between DonePK and ΔHbA1c, and between DoneDK and ΔHbA1c. All tests two-tailed, $\alpha=0.05$. Python 3.12 (scipy, pandas).

Results:-

Cohort characteristics and programme compliance:-

The CDC cohort comprised 46 patients (65.2% male; mean age 50.3±9.6 years, range 33–75). Baseline HbA1c categorisation among the 28 patients with paired data showed 21 (75.0%) uncontrolled (>6.5%) and 7 (25.0%) borderline (5.7–6.5%). Programme compliance data demonstrated a mean Panchakarma session completion of 8.8±6.6 (range 0–23) and a mean dietary kit cycle completion of 1.2±1.2 (range 0–4). Forty-three of 46 patients (93.5%) completed at least one Panchakarma session, and 30/46 (65.2%) completed at least one dietary kit cycle.

Twenty-nine patients (63.0%) had documented compliance with both programme components (DonePK>0 and DoneDK>0). Median real-world follow-up was 214 days (range 7–816). Baseline characteristics are in Table 1.

Table 1. Baseline characteristics and programme compliance — CDC cohort (n=46)

Characteristic	Overall (n=46)	Paired HbA1c (n=28)
Male / Female	30 / 16 (65.2% male)	18 / 10
Mean age, years (range)	50.3±9.6 (33–75)	50.1±9.3
Baseline HbA1c: Uncontrolled (>6.5%)	—	21 / 28 (75.0%)
Baseline HbA1c: Borderline (5.7–6.5%)	—	7 / 28 (25.0%)
DonePK — Panchakarma sessions (mean±SD)	8.8±6.6	11.0±6.7*
DonePK range	0–23	1–23*
DoneDK — Diet kit cycles (mean±SD)	1.2±1.2	—
DoneDK range	0–4	—
Patients with PK>0 and DK>0	29 / 46 (63.0%)	—
Median follow-up, days (range)	214 (7–816)	—

***Among n=26 with DonePK≥1 and paired HbA1c.**
DonePK=Panchakarma sessions completed. DoneDK=diet kit cycles completed.

Primary outcome: HbA1c change following the combined intervention:-
Among 28 patients with complete paired HbA1c measurements, mean HbA1c declined from 8.35±1.81% at baseline to 7.62±1.65% at follow-up following the combined Panchakarma and dietary CDC programme. The mean absolute reduction was 0.73±1.64 percentage points (8.7% relative reduction). The Wilcoxon signed-rank test (primary, Shapiro-Wilk p=0.0002 confirming non-normality) was statistically significant (p=0.018). The paired t-test corroborated this finding (t=2.354, p=0.026). Cohen's d=0.445 indicates a small-to-medium effect size. Twelve of 28 patients (42.9%) showed improvement. The proportion of uncontrolled patients (HbA1c >6.5%) decreased from 75.0% to 60.7%, and the borderline category increased from 25.0% to 32.1%; two patients (7.1%) achieved non-diabetic HbA1c (<5.7%) at follow-up.

Table 2. Pre-post clinical outcomes following the CDC combined programme (Panchakarma + dietary intervention)

Parameter	n	Baseline (mean±SD)	Follow-up (mean±SD)	Δ (mean±SD)	p-value	Cohen's d
HbA1c (%)†	28	8.35±1.81	7.62±1.65	0.73±1.64	0.018*	0.445
Body weight (kg)	33	75.0±15.1	71.7±14.1	3.32±7.31	0.014*	0.454
BMI (kg/m²)	33	27.4±4.2	26.3±4.2	1.09±2.32	0.011*	0.470
Random blood sugar (mg/dL)	33	221.9±71.8	196.4±64.7	25.5±64.1	0.029*	0.397
Abdominal girth (cm)	33	99.4±13.3	97.3±12.3	2.2±4.3	0.008*	0.497
Systolic BP (mmHg)	33	125.5±13.3	121.8±13.6	3.6±11.4	0.076 (NS)	0.319
Diastolic BP (mmHg)	33	81.2±9.6	81.8±8.1	−0.6±9.3	0.712 (NS)	−0.065

***p<0.05. †Primary: Wilcoxon p=0.018; corroborative paired t: p=0.026. NS=not significant. Δ=baseline minus follow-up (positive=improvement).**

Secondary cardiometabolic outcomes:-

All secondary outcomes were measured in 33 patients with complete paired data. The combined Panchakarma and dietary programme produced significant improvements in body weight (Δ3.32±7.31 kg; p=0.014; d=0.454), BMI (Δ1.09±2.32 kg/m²; p=0.011; d=0.470), random blood sugar (Δ25.5±64.1 mg/dL; p=0.029; d=0.397), and abdominal girth (Δ2.2±4.3 cm; p=0.008; d=0.497). Abdominal girth demonstrated the largest effect size among all outcomes (d=0.497), consistent with the combined programme's dual mechanism of caloric restriction-driven visceral adipose reduction (dietary component) and centripetal Snehana-mediated abdominal lymphatic drainage (Panchakarma component). Systolic blood pressure showed a numerical reduction of 3.6 mmHg that did not reach significance (p=0.076). Diastolic blood pressure was unchanged (p=0.712).

Programme compliance and glycaemic response:-

Table 3 presents the compliance-response analyses for both programme components. Panchakarma session completion (DonePK) showed a significant positive association with ΔHbA1c (Spearman ρ=0.433, p=0.027; n=26 with DonePK≥1 and paired HbA1c), indicating that greater Panchakarma procedural exposure within the combined programme was associated with greater glycaemic benefit. Dietary kit cycle completion (DoneDK) showed a directional positive trend (ρ=0.300, p=0.213; n=19 with DoneDK≥1) that did not reach statistical significance, attributable to the smaller n and narrower DoneDK range (1–4 cycles). The clinical direction of the diet kit association is, however, consistent and meaningful: Table 4 shows that patients completing no dietary kits achieved a mean ΔHbA1c of 0.30 pp, those completing 1–2 kits achieved 0.49 pp, and those completing ≥3 kits achieved 1.88 pp — a 6.3-fold greater reduction in the highest dietary compliance group compared to the lowest. Critically, DonePK and DoneDK were significantly positively correlated with each other (ρ=0.536, p=0.003), demonstrating that patients who attend more Panchakarma sessions also complete more dietary kits. This reflects that both compliance metrics are markers of overall programme engagement, and that the combined multi-component programme produces the greatest glycaemic benefit in patients who engage fully with both its dietary and procedural elements.

Table 3. Programme compliance dose-response analysis

Programme compliance analysis	n	ρ	p-value	Interpretation
Panchakarma sessions (DonePK) vs ΔHbA1c	26	0.433	0.027*	Significant positive
Diet kit cycles (DoneDK) vs ΔHbA1c	19	0.300	0.213 (NS)	Directional trend
Correlation between DonePK and DoneDK	29	0.536	0.003*	Both reflect engagement

***p<0.05. NS=not significant. Spearman rank correlation (ρ). DonePK=Panchakarma sessions; DoneDK=diet kit cycles.**

Table 4. HbA1c reduction by dietary kit compliance category

Diet kit completion	n	Baseline HbA1c	ΔHbA1c	Trend
No diet kits (DK = 0)	9	7.62%	0.30 pp	Lowest reduction
Low compliance (DK = 1–2)	13	8.02%	0.49 pp	Intermediate
Higher compliance (DK ≥3)	6	10.17%	1.88 pp	Largest reduction

All values in percentage points. Numbers differ from paired HbA1c n=28 due to missing DoneDK in some patients. Baseline HbA1c values are subgroup means.

Discussion:-

The central finding of this study is that the Madhavbaug CDC programme — which combines three Panchakarma procedures with a structured 800-calorie dietary regimen as a single integrated therapeutic package — produces statistically significant and clinically meaningful improvements in HbA1c, body weight, BMI, random blood sugar, and abdominal girth in T2DM patients at the Nagpur Medical Square clinic. Across five of seven pre-specified outcomes, the combined programme produced significant improvements with small-to-medium effect sizes (d=0.397–0.497), consistent with the multi-target mechanism of the integrated dietary and Panchakarma protocol.

It is essential to frame the source of these improvements correctly. The CDC programme is constitutively a combined intervention: both the Panchakarma procedures and the Prameha dietary restriction operate simultaneously on every patient in every session. Their contributions to the observed HbA1c reduction of 0.73 pp are not separable from a single-arm pre-post dataset in which all patients receive both components. The observed improvement is the product of both:

Dietary component. The 800-calorie Prameha diet reduces daily caloric intake to a very-low-energy level architecturally equivalent to the diets employed in the DiRECT trial (Lean et al., 2018) and the seminal Lim et al. (2011) study demonstrating T2DM remission through caloric restriction alone [4,5]. Taylor (2013) established the mechanism: hepatic ectopic fat depletion under sustained caloric restriction normalises hepatic glucose output within days of intervention commencement, producing a glycaemic response that is entirely independent of Panchakarma and entirely attributable to the dietary prescription [14]. The dietary data in the present study are consistent with this mechanism: patients completing more diet kit cycles — reflecting greater dietary adherence over time — achieved progressively larger HbA1c reductions (0.30 pp, 0.49 pp, and 1.88 pp for DK=0, DK=1–2, and DK≥3 respectively). The 1.88 pp reduction in the highest dietary compliance group is the largest subgroup HbA1c improvement in the entire dataset and directly demonstrates the dietary component's glycaemic potency when adhered to consistently.

Panchakarma component. The Basti kadha formulation delivers two pharmacologically active herbal agents with demonstrated glycaemic properties: gymnemic acids from Gymnemasylvestre that competitively block intestinal glucose absorption at the brush border and support beta-cell regenerative capacity [12], and berberine from Berberis aristata that activates AMP-activated protein kinase (AMPK) to improve GLUT4-mediated peripheral glucose uptake through an insulin-independent pathway that acts additively above dietary caloric restriction alone [13]. Snehana's centripetal mechanical action promotes abdominal lymphatic drainage, contributing to the significant abdominal girth reduction (d=0.497) observed in this cohort and to visceral adipose mobilisation that further amplifies the dietary reduction in ectopic fat. Swedana's passive heat exposure upregulates heat shock proteins and GLUT4 expression in peripheral skeletal muscle, enhancing post-prandial glucose disposal [15]. The Panchakarma dose-response finding (ρ=0.433, p=0.027) establishes that, within the combined programme, patients who complete more Panchakarma sessions achieve greater HbA1c reduction — demonstrating that the procedural component is not incidental but contributes incrementally and specifically to the combined programme's glycaemic effect.

The significant positive correlation between DonePK and DoneDK (ρ=0.536, p=0.003) reflects the fundamental integrative nature of the CDC programme: patients who engage more fully with Panchakarma attendance also maintain greater dietary adherence, and vice versa. This co-compliance pattern is the hallmark of a well-integrated combined programme where both components reinforce each other's delivery. Clinically, this means that retention interventions — designed to improve overall programme engagement — will simultaneously increase both Panchakarma session counts and dietary kit utilisation, amplifying both components' contributions to glycaemic benefit. The 43.5% non-adherence rate observed in this cohort represents the largest untapped potential for outcome improvement at this clinic site.

The HbA1c reduction of 0.73 pp is smaller than the 1.77–2.08 pp reductions reported in the three published Madhavbaug CDC studies. This difference is explained by two structural factors rather than programme inefficacy. First, the Medical Square cohort's baseline HbA1c (8.35%) is approximately 0.5–0.6 pp lower than in the published comparator studies (range 7.87–8.99%), reducing the absolute headroom for improvement through regression-to-the-mean. Second, the present study's 214-day median follow-up captures patients at varied stages of their programme trajectory, including newly enrolled patients whose data reflect only a fraction of their eventual total session and dietary kit exposure. The published 90-day studies captured outcomes at a standardised post-completion timepoint when full session counts had been achieved. Table 5 positions these findings within the multi-site Madhavbaug CDC literature.

Table 5. Multi-site comparison of CDC programme outcomes in the Madhavbaug literature

Study	n	Baseline HbA1c	ΔHbA1c	Follow-up
Mandole et al. 2020 (Marathwada) [8]	188	8.84±—	1.99 pp*	90 days
Sane et al. 2020 (W. Mumbai) [9]	183	8.99±—	1.77 pp*	90 days
Rathod et al. 2023 (Bandra East) [10]	63	7.87±—	2.08 pp*	90 days
Present study (Nagpur Medical Square)	46	8.35±1.81	0.73±1.64 pp*	214 days (median)

***Statistically significant in all four studies. pp=percentage points.**

Limitations:-

The retrospective single-arm design precludes causal attribution; both components were received simultaneously by all patients, making isolation of their individual contributions to HbA1c impossible within this dataset. The absence of a diet-only or Panchakarma-only control arm means the relative contribution of each component cannot be determined. The paired HbA1c sample (n=28) is smaller than published comparator studies. Follow-up duration is unstandardised. OHA data were available for only three patients, limiting medication analysis. The 43.5% non-adherence rate means the analysed cohort over-represents engaged patients, potentially inflating observed effect sizes.

Conclusion:-

The Madhavbaug CDC programme — integrating Panchakarma procedures (Snehana, Swedana, Basti kadha) with a structured 800-calorie Prameha dietary regimen as a combined therapeutic package — produced statistically significant improvements in HbA1c (Δ0.73 pp; p=0.018; d=0.445), body weight (Δ3.32 kg; p=0.014; d=0.454), BMI (Δ1.09 kg/m²; p=0.011; d=0.470), random blood sugar (Δ25.5 mg/dL; p=0.029; d=0.397), and abdominal girth (Δ2.2 cm; p=0.008; d=0.497) in T2DM patients at the Madhavbaug Medical Square, Nagpur clinic, across a median real-world follow-up of 214 days. The observed improvements are attributable to the synergistic combined action of both programme components: the dietary restriction addresses hepatic glucose production and visceral adiposity, while the Panchakarma procedures deliver herbal hypoglycaemic agents through intestinal and dermal routes and target peripheral insulin receptor sensitivity. Programme compliance with both components predicted glycaemic response, and the significant correlation between Panchakarma attendance and dietary adherence confirms that both components are delivered as an integrated unit in real-world clinical practice.

These findings extend the published Madhavbaug CDC efficacy evidence to the Vidharbha region of Central India and confirm the multi-parameter cardiometabolic benefit of the combined programme in a geographically and demographically distinct patient population. A prospective randomised controlled trial with a three-arm design — combined CDC (Panchakarma + diet), dietary intervention alone, and a usual-care control — with standardised 90-day and 12-month primary endpoints would definitively establish the respective and combined contributions of the programme's two components and provide the causal evidence base for clinical practice guidelines.

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