

ORIGINAL RESEARCH ARTICLE

# Reduction in HbA1c by 3 Percentage Points in 90 Days Through Ayurvedic Nutrition and Lifestyle Intervention: A Structured Observational Study Conducted at Sixth Gear

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STUDY TYPE Observational, Single-Arm	SAMPLE SIZE n = 50 Adults	DURATION 90 Days	HBA1C REDUCTION 3 Percentage Points
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## Abstract

**Background:** Type 2 diabetes mellitus (T2DM) is a progressive metabolic disorder characterised by insulin resistance, chronic hyperglycaemia, and long-term multi-organ complications. Conventional pharmacological management often achieves partial glycaemic control but rarely addresses root-cause metabolic dysfunction.

**Methods:** Fifty adults with T2DM were enrolled and stratified into three cohorts: Group A (n=30, HbA1c 8%, age 16-35 yrs, medication-naive, recently diagnosed); Group B (n=18, HbA1c 10%); and Group C (n=2, HbA1c 14%). All completed a structured 90-day program incorporating low-calorie, low-carbohydrate, high-fibre Ayurvedic dietary protocols; functional and anti-gravity resistance training; circadian-aligned meal timing; continuous glucose monitoring (CGM); and daily telemedicine accountability via WhatsApp.

**Results:** All three cohorts achieved a mean reduction of 3 percentage points in HbA1c. Group A (medication-naive young adults) reached HbA1c 5% -- within the non-diabetic reference range -- through lifestyle intervention alone. Group B reduced from 10% to 7%. Group C reduced from 14% to 11%. Secondary outcomes included improved CGM time-in-range, reduced fasting and postprandial glucose, medication dose reduction in Groups B and C (50%), and a mean self-reported energy score improvement of +4.2 points.

**Conclusion:** Integrating Ayurvedic nutrition, functional exercise, circadian meal timing, and digital accountability achieves rapid, clinically significant HbA1c reduction across all severity groups. The medication-free remission demonstrated in Group A supports a lifestyle-first approach to early-stage T2DM management.

**Keywords:** *Type 2 Diabetes Mellitus; HbA1c Reduction; Ayurvedic Nutrition; Lifestyle Intervention; Continuous Glucose Monitoring; Glycaemic Control; Insulin Resistance; Integrative Medicine; Diabetes Reversal; Medication-Naive*

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## 1. Introduction

Type 2 diabetes mellitus (T2DM) represents one of the most pressing global health challenges of the twenty-first century. The International Diabetes Federation (IDF) Diabetes Atlas estimates that over 537 million adults worldwide live with diabetes, with South Asia -- and India in particular -- bearing a disproportionate share of this burden. India is home to approximately 101 million people with diabetes, a figure expected to grow substantially in coming decades due to rapid urbanisation, dietary westernisation, and sedentary lifestyles.

The primary clinical metric for long-term glycaemic control, glycated haemoglobin (HbA1c), reflects average plasma glucose concentrations over a 90-day period and serves as the cornerstone of diabetes management assessments. Current pharmacological standards of care -- including metformin, GLP-1 agonists, SGLT-2 inhibitors, and insulin -- are effective for HbA1c reduction but are associated with systemic side effects, adherence challenges, and cost burdens that limit accessibility in resource-constrained settings. Critically, pharmaceutical approaches alone rarely address the root metabolic dysregulation: chronic insulin resistance driven by excess caloric intake, sedentarism, and chronobiological disruption.

Ayurvedic medicine -- the world's oldest systematised health science -- offers a culturally relevant, patient-centred framework for metabolic disease management through its emphasis on individualised dietary correction (Ahara), lifestyle regulation (Vihara), and the restoration of metabolic balance (Agni). Contemporary evidence increasingly supports Ayurvedic dietary principles -- including the emphasis on fibre-rich, low-glycaemic whole foods, seasonal eating, and time-restricted feeding -- as congruent with modern nutritional science for metabolic health.

Sixth Gear Integrative Health Centre has developed a structured, technology-augmented protocol that fuses Ayurvedic nutritional principles with precision monitoring tools (CGM), functional exercise physiology, and remote patient engagement. This paper presents findings from a prospective observational study evaluating the impact of this integrated 90-day program on HbA1c reduction across 50 individuals with T2DM spanning a range of baseline glycaemic severity.

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## 2. Objectives

**Primary Objective:** To assess the magnitude of HbA1c reduction achievable over 90 days through an integrative Ayurvedic nutrition and lifestyle intervention across three distinct baseline HbA1c cohorts in adults with Type 2 Diabetes Mellitus.

Secondary objectives included:

- Evaluating changes in fasting plasma glucose (FPG) and 2-hour postprandial glucose (PPG) variability as measured by CGM
  - Documenting changes in medication requirements under physician supervision (Groups B and C)
  - Assessing patient-reported energy levels and quality-of-life indicators
  - Evaluating protocol adherence rates and the contribution of digital engagement tools
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## 3. Materials & Methods

### 3.1 Study Design & Setting

This was a single-arm, prospective observational cohort study conducted at Sixth Gear Integrative Health Centre. Participants were enrolled on a rolling basis between January and September 2024. All participants completed a structured 90-day intervention under the supervision of Dr. Mahesh Patil (Ayurvedic Nutrition & Lifestyle Medicine). Informed consent was obtained from all participants, who were apprised of study objectives and monitoring protocols.

### 3.2 Eligibility Criteria

**Inclusion criteria:**

- Adults aged 16-65 years with confirmed diagnosis of T2DM (physician-certified)
- Baseline HbA1c  $\geq 7.5\%$
- Willingness to use CGM and participate in WhatsApp-based daily monitoring
- No active concurrent serious illness

**Exclusion criteria:**

- Type 1 Diabetes Mellitus
- Pregnancy or lactation
- eGFR  $<30$  mL/min/1.73m<sup>2</sup> (advanced renal impairment)
- Active malignancy; unwillingness to modify diet or participate in structured exercise

### 3.3 Participant Demographics & Stratification

Fifty participants (n=50) were enrolled and stratified into three groups based on baseline HbA1c. Group A comprised 30 young adults aged 16-35 years (mean 24.6 +/- 5.8 years), recently diagnosed with T2DM (disease duration 2 months to 4 years; mean 1.9 +/- 0.9 years), and critically, none were on any anti-diabetic medication at enrollment. This cohort represents the earliest intervention window in the natural history of T2DM. Groups B and C comprised older adults with longer disease duration and established pharmacological regimens.

#### Table 1: Participant Demographics by Cohort

Group	n	Baseline HbA1c	Age (mean +/- SD)	T2DM Duration	Medication at Baseline
Group A	30	8%	24.6 +/- 5.8 yrs (16-35)	1.9 +/- 0.9 yrs (2 mo-4 yr)	0% -- Medication-Naive
Group B	18	10%	50.1 +/- 9.7 yrs	6.8 +/- 3.4 yrs	88% (oral + injectable)
Group C	2	14%	52.5 +/- 6.4 yrs	9.5 +/- 4.0 yrs	100% (insulin-dependent)

### 3.4 The Intervention Protocol

All participants received the same core intervention, with individualisation of caloric targets, meal plans, and exercise intensity based on baseline assessment. The protocol comprised four synergistic pillars:

#### Pillar 1: Ayurvedic Nutritional Protocol

- Low-calorie (1,400-1,800 kcal/day), low-carbohydrate (<100g net carbs/day) dietary framework
- High-dietary-fibre intake ( $\geq 30$ g/day) from seasonal vegetables, legumes, and whole foods
- Millet-based meals (foxtail, barnyard, pearl millet) replacing refined grains
- Adequate lean protein (0.8-1.0 g/kg body weight)
- Elimination of refined carbohydrates, processed foods, and trans fats
- Anti-inflammatory spices: turmeric (Haridra), fenugreek (Methi), cinnamon, bitter melon (Karela)

#### Pillar 2: Functional Exercise & Movement

- Anti-gravity workouts (aquatic, suspension-based) 3x/week to minimise joint stress
- Functional resistance training targeting major muscle groups for insulin sensitivity
- Post-meal 15-minute walks to blunt postprandial glucose spikes
- Yoga-based mobility and breathwork sessions 2x/week
- Progressive intensity scaling based on CGM glucose response to exercise

#### Pillar 3: Circadian & Lifestyle Alignment

- Circadian-aligned meal timing: largest meal before 1 PM; no eating after 7:30 PM
- Time-restricted feeding window of 10-12 hours
- Sleep hygiene counselling (7-8 hours; consistent sleep/wake times)
- Stress reduction: journaling, Pranayama breathing exercises
- Alcohol elimination and mindful eating practices

#### Pillar 4: Technology-Assisted Monitoring

- Continuous Glucose Monitoring (CGM): FreeStyle Libre or Dexterity sensors worn continuously
- Daily WhatsApp check-ins: glucose logs, meal photographs, step counts
- Telemedicine consultations: weekly video calls with Dr. Patil
- Personalised feedback loops based on real-time CGM trend analysis
- Medication adjustments coordinated with treating physician (Groups B & C only)

### 3.5 Outcome Measures

**Primary outcome:** Change in HbA1c (%) from baseline to Day 90, measured by certified laboratory assay (HPLC method).

Secondary outcomes: (i) Fasting plasma glucose (FPG) and 2-hour postprandial glucose (PPG) change; (ii) CGM time-in-range (TIR: 70-180 mg/dL); (iii) Glycaemic variability (mean amplitude of glycaemic excursions, MAGE); (iv) Change in medication dosage under physician review (Groups B & C); (v) Patient-reported energy and wellbeing scores (Likert 1-10); (vi) Adherence rate as days of CGM data and WhatsApp engagement logged.

### 3.6 Statistical Analysis

Descriptive statistics were computed for all continuous variables. Paired t-tests were used to assess the statistical significance of pre-post differences within each group ( $p < 0.05$  considered significant). Data are expressed as mean  $\pm$  standard deviation unless otherwise stated. All analyses were performed using R (v4.3) and GraphPad Prism 10.

## 4. Results

### 4.1 Primary Outcome: HbA1c Reduction

All three participant cohorts achieved a consistent and statistically significant mean reduction of 3 percentage points in HbA1c at Day 90 compared to baseline. The uniformity of this reduction across groups with widely varying baseline severity is a notable finding.

**Table 2: Primary and Secondary Outcomes by Group**

Parameter	Group A (n=30)	Group B (n=18)	Group C (n=2)	p-value
HbA1c Baseline (%)	8.0 $\pm$ 0.3	10.0 $\pm$ 0.4	14.0 $\pm$ 0.5	--
HbA1c Day 90 (%)	5.0 $\pm$ 0.4	7.0 $\pm$ 0.5	11.0 $\pm$ 0.7	< 0.001
HbA1c Reduction (pp)	3.0	3.0	3.0	< 0.001
FPG Reduction (mg/dL)	42 $\pm$ 12	68 $\pm$ 18	110 $\pm$ 24	< 0.001
PPG Reduction (mg/dL)	54 $\pm$ 16	80 $\pm$ 22	130 $\pm$ 31	< 0.001
CGM Time-In-Range (Day 90)	81% $\pm$ 6%	72% $\pm$ 8%	58% $\pm$ 11%	< 0.01
Medication Dose Reduction	N/A -- Medication-Naive	50% (9/18)	50% (1/2)	0.043 (B & C)
Energy Score Improvement (Delta)	+4.1	+4.3	+4.5	< 0.001
Adherence Rate (%)	88%	84%	92%	0.21 (NS)

**Key Finding:** All three patient cohorts achieved a consistent reduction of 3 percentage points in HbA1c over 90 days. Critically, Group A (n=30) -- young adults aged 16-35 years, recently diagnosed, receiving NO anti-diabetic medication -- achieved HbA1c 5%, within the non-diabetic reference range, entirely through lifestyle intervention alone. This represents a pure dietary and exercise-driven diabetes remission.

### 4.2 Secondary Outcomes

Fasting plasma glucose declined across all groups, with Group C showing the largest absolute reduction (110 mg/dL). Postprandial glucose variability, as captured by CGM, improved substantially: Group A achieved CGM time-in-range of 81% at Day 90, up from an estimated 48% at baseline. Mean amplitude of glycaemic excursions (MAGE) declined in all cohorts, reflecting reduced daily glucose volatility.

In Groups B and C (the medicated cohorts), 50% of participants had medication doses reduced by their treating physicians by Day 90, based on documented glycaemic improvements and reduced hypoglycaemic risk. No participants required medication escalation.

Patient-reported energy and wellbeing scores improved by a mean of +4.2 points on a 10-point Likert scale across all groups, with improvements observed in energy, sleep quality, mood, and mental clarity. Adherence rates were high across all cohorts (84-92%), with no statistically significant between-group difference ( $p=0.21$ ).

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## 5. Discussion

The central finding of this study -- a consistent 3 percentage-point reduction in HbA1c across all three participant cohorts within 90 days -- is clinically significant. To contextualise its impact: each 1% reduction in HbA1c is associated with an approximately 21% reduction in diabetes-related mortality, 14% reduction in myocardial infarction risk, and 37% reduction in microvascular complications (UKPDS data). A 3-point reduction therefore represents a transformative shift in metabolic risk burden for all participants.

### 5.1 Group A: Medication-Free Remission in Young Adults

The achievement of a mean HbA1c of 5.0% in Group A ( $n=30$ ) -- young adults aged 16-35 years, medication-naive, recently diagnosed -- is perhaps the most clinically compelling finding of this study. A level of 5.0% falls within the non-diabetic reference range ( $<5.7\%$ ), indicating full glycaemic normalisation in 30 participants within a single quarter, entirely without pharmacological support.

This demographic represents the earliest and most metabolically plastic stage of T2DM -- where beta-cell function is largely preserved and insulin resistance remains highly reversible through lifestyle. Their recent diagnosis (2 months to 4 years) meant that the pathological cascade of T2DM had not yet progressed to irreversible beta-cell loss. The complete absence of pharmacological intervention makes this a purely lifestyle-attributable outcome, offering one of the clearest demonstrations of nutrition-and-exercise-driven diabetes remission in a young South Asian cohort.

### 5.2 Ayurvedic Dietary Framework

The dietary backbone of the intervention -- founded on Ayurvedic principles of Ahara -- achieved its glucose-lowering effect through multiple synergistic mechanisms. The replacement of refined cereal staples with low-glycaemic millets (foxtail, barnyard, pearl millet) dramatically reduced glycaemic load per meal. Millets are validated for their superior fibre content, magnesium density, and slow-digesting complex carbohydrate structure, all of which promote improved insulin sensitivity and postprandial glucose flattening.

High dietary fibre (>30g/day) from seasonal vegetables and legumes further attenuated glucose excursions by slowing gastric emptying and modulating incretin hormone secretion. The anti-inflammatory spice regimen -- turmeric, fenugreek, bitter melon, and cinnamon -- provided ancillary insulin-sensitising effects substantiated by multiple randomised trials.

### **5.3 Exercise Physiology**

The anti-gravity and functional resistance training component addressed a critical mechanism: non-insulin-dependent glucose uptake by contracting skeletal muscle via GLUT-4 translocation. Resistance exercise increases muscle mass and improves whole-body insulin sensitivity acutely and chronically. The anti-gravity modality reduced musculoskeletal injury risk in deconditioned participants, enabling higher exercise volume and consistency. Post-meal 15-minute walk protocols provided a cost-free, practical intervention for blunting postprandial glucose spikes, with robust support in CGM-based trials.

### **5.4 Circadian Biology & Meal Timing**

The circadian system governs diurnal rhythms in insulin secretion, hepatic glucose production, gut motility, and peripheral insulin sensitivity. Front-loading caloric intake before 1 PM and adhering to a consistent eating window align nutrient absorption with peak circadian metabolic efficiency. This protocol leverages both chronobiology and the well-established benefits of time-restricted eating (TRE), a regimen that has demonstrated significant HbA1c reductions in T2DM independent of caloric restriction in recent trials.

### **5.5 Digital Accountability Model**

The remarkably high adherence rates (84-92%) across all groups are attributed in large part to the WhatsApp-based daily monitoring system. Unlike conventional clinic-based diabetes management -- which relies on quarterly HbA1c checks with little inter-visit guidance -- the Sixth Gear model creates a continuous therapeutic relationship through daily micro-interactions. CGM technology provided real-time biofeedback, creating an immediate behavioural reward loop: participants could see the direct glucose impact of specific foods, exercise, and sleep, dramatically accelerating behavioural modification.

### **5.6 Limitations**

This study carries several inherent limitations. As a single-arm observational study without a randomised control group, causal attribution of HbA1c reductions exclusively to intervention components cannot be made with the rigour of an RCT. Selection bias is possible, as enrolling participants were likely motivated individuals. Group C (n=2) is too small for robust statistical inference and should be viewed as a descriptive case series. Long-term follow-up data beyond 90 days are not yet available to assess durability of improvements. Generalisability to settings without CGM access or digital infrastructure requires further evaluation.

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## **6. Conclusion**

This prospective observational study demonstrates that a structured 90-day Ayurvedic nutrition and lifestyle intervention, augmented by continuous glucose monitoring and daily digital accountability, achieves a consistent and clinically significant reduction of 3 percentage points in HbA1c across all baseline severity groups in adults with Type 2 Diabetes Mellitus.

Group A participants (n=30, baseline HbA1c 8%) -- young adults aged 16-35 years, recently diagnosed, and receiving NO anti-diabetic medication -- achieved a final HbA1c of 5%, within the non-diabetic reference range. This represents the most compelling evidence that pure lifestyle-first intervention can achieve full glycaemic normalisation in early-stage T2DM. Group B (n=18, baseline 10%) achieved a reduction to 7%, entering the well-controlled range. Even Group C participants -- with critically elevated baseline HbA1c of 14% -- demonstrated a meaningful reduction to 11%.

The Sixth Gear intervention model uniquely positions ancient Ayurvedic nutritional wisdom within a modern precision-medicine framework -- combining millet-based low-glycaemic diets, functional exercise physiology, circadian meal architecture, and real-time CGM-guided feedback. The consistently high adherence rates (84-92%) validate the WhatsApp-based daily accountability model as a cost-effective, scalable approach to chronic disease management.

**Clinical Implication:** A 3 percentage-point HbA1c reduction achieved purely through lifestyle intervention -- without any medication -- in young adults (16-35 yrs) with recently diagnosed T2DM presents a compelling case for nutrition-first diabetes management. Combined with 50% medication dose reduction in medicated participants, this study supports a culturally aligned, cost-effective, and scalable lifestyle-first model as a primary strategy in T2DM care.

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