

## EVALUATING THE EFFECTIVENESS OF AYURVEDIC AND NATUROPATHIC THERAPIES ON GLYCEMIC AND LIPID PARAMETERS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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### Abstract

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by hyperglycemia, impaired insulin action, and frequent abnormalities in lipid metabolism. As diabetes progresses, the risk of cardiovascular disease, neuropathy, nephropathy, and reduced quality of life also increases. Because long-term control requires continuous lifestyle management, many patients seek supportive non-pharmacological systems such as Ayurveda and naturopathy. The present study evaluates the effectiveness of Ayurvedic and naturopathic therapies on glycemic and lipid parameters in patients with T2DM using a simulated comparative dataset. Sixty hypothetical patients were distributed equally between an Ayurvedic therapy group and a naturopathic therapy group and were observed across a 12-week intervention period. The selected outcomes included fasting blood sugar, postprandial blood sugar, HbA1c, total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides. This study presents the findings through simple tables and chart-based explanation so that the analytical flow remains easy to read. The simulated analysis shows that both interventions produce favorable movement in metabolic markers, with the Ayurvedic group showing slightly stronger glycemic improvement and both groups showing meaningful lipid improvement. These therapies may be relevant as adjunctive models of care when integrated with conventional treatment, adherence support, and professional monitoring. At the same time, future real-world studies should use more robust trial design, longer follow-up, and standardized treatment protocols.

**Keywords:** Ayurveda, naturopathy, type 2 diabetes mellitus, glycemic control, lipid profile, complementary therapy, integrative care.

### 1. Introduction

Diabetes is a chronic disease that develops when the body does not produce enough insulin or cannot effectively use the insulin it produces. More than 95% of people living with diabetes have type 2 diabetes, making T2DM the principal focus of global diabetes prevention and management efforts (World Health Organization, 2024). Because T2DM is closely associated with overweight, physical inactivity, unhealthy diet, and progressive insulin resistance, its management depends not only on medicine but also on durable lifestyle regulation.

In routine clinical practice, glycemic control is usually discussed through fasting blood glucose, postprandial blood glucose, and HbA1c. Yet these indicators alone do not fully reflect the metabolic burden of T2DM. Many patients also develop dyslipidemia, including elevated total cholesterol, high LDL, low HDL, and raised triglycerides. For this reason, interventions that simultaneously improve glycemic and lipid outcomes are of special significance. They address both short-term symptom control

and longer-term cardiovascular risk reduction. Across many communities, especially in South Asia, patients often combine standard diabetes care with traditional or complementary systems such as Ayurveda and naturopathy. These systems attract interest because they emphasize food regulation, body routine, exercise, mental calmness, and the belief that chronic disease management requires whole-person rather than symptom-only care. In addition, such approaches may improve patient motivation because they involve active participation rather than passive medicine consumption alone.

The present study was revised to match academic preferences for simple and readable presentation. Accordingly, the tables do not use mean plus-minus statistical notation. Instead, they display direct pre-test values, post-test values, numerical change, and percentage improvement. Charts have also been added to visually represent key tables. The final document is organized as a professional analytical study with an expanded literature review, enlarged methodology section, results, discussion, conclusion, and references placed at the end only.

## **2. Literature Review**

### **2.1 Evidence on Ayurveda and T2DM**

Published research increasingly suggests that Ayurvedic treatment may contribute to better glycemic regulation when it is used in a structured and supervised way. Chattopadhyay et al. (2022), in a systematic review and meta-analysis, concluded that several Ayurvedic medicines were associated with improved glycemic control in T2DM patients. The review reported reductions in fasting blood glucose and HbA1c across a range of botanical and compound interventions, but it also noted that the quality of evidence varied substantially from study to study. This means that current findings are encouraging, yet still require careful interpretation.

Gordon, Rice, and Allman-Farinelli (2019) described Ayurveda as a holistic system that extends beyond single-herb treatment. They highlighted that Ayurvedic care often combines herbal formulations with dietary advice, daily routine correction, physical activity, and individualized assessment. Such a framework is especially relevant to T2DM because diabetes outcomes are strongly influenced by eating pattern, digestive regulation, stress exposure, sleep, and long-term health behavior. From this perspective, Ayurveda may support metabolic control through multiple interacting pathways rather than a single glucose-lowering mechanism.

Another important feature of Ayurveda is its individual-centered orientation. Rather than applying a completely uniform therapeutic package to all patients, Ayurvedic practice often adapts food planning, herbs, and daily schedule according to patient constitution and symptom pattern. In real research settings, this creates both opportunity and difficulty. The opportunity lies in personalized care; the difficulty lies in standardization, because individualized therapies are harder to evaluate through rigid trial protocols. This tension partly explains why literature on Ayurvedic diabetes management often shows promising but heterogeneous results.

### **2.2 Evidence on Naturopathy, Yoga, and Lifestyle-Based Care**

The literature on naturopathy is similarly centered on diet, movement, behavioral regulation, and mind-body practices. Bairy et al. (2020) found that an integrated naturopathy and yoga program produced promising glycemic outcomes in T2DM patients, particularly in the short term. Their work emphasized the role of calorie control, plant-based dietary patterns, physical activity, yoga, and stress reduction as mutually reinforcing components. Such findings are highly relevant to diabetes care because long-term glucose reduction often depends on behavioral consistency rather than single-point treatment decisions.

An earlier cohort analysis by Bairy et al. (2016) further indicated that adjunctive naturopathy may be associated with better glycemic control and reduced medication requirement among T2DM patients. This suggests that naturopathy may function best when embedded in an integrative care model. Instead

of replacing conventional medicine, it may strengthen self-management, dietary discipline, and symptom monitoring. This interpretation is consistent with broad public health guidance that prioritizes physical activity, weight control, and healthy diet as key pillars of diabetes prevention and management (World Health Organization, 2024).

Yoga is frequently incorporated into naturopathic diabetes care, and therefore yoga-centered evidence helps explain naturopathy-related outcomes. Chen et al. (2022) reported in a systematic review and meta-analysis that yoga can improve blood glucose and lipid parameters in T2DM patients. Ghazvineh et al. (2022) also concluded that yoga interventions appear to have a substantial effect on lipid profile, although they recommended more rigorous studies before firm clinical conclusions are drawn. These findings are important because they connect lifestyle, stress regulation, and metabolic improvement within one coherent therapeutic logic.

### 2.3 Critical Synthesis and Research Gap

A cross-reading of the literature reveals that both Ayurveda and naturopathy share three major strengths. First, they are lifestyle-intensive rather than drug-centered approaches. Second, they often address both glucose and lipid abnormalities simultaneously. Third, they may improve patient engagement by making disease management a daily practice rather than an occasional clinical event. These common strengths explain why many patients perceive them as sustainable and meaningful forms of support in chronic disease care.

At the same time, the literature also reveals a common weakness: methodological inconsistency. Samples are often small, treatment packages vary across studies, follow-up periods are limited, and intervention reporting is sometimes incomplete. Reviews therefore tend to conclude that the evidence is promising but not definitive. McBenedict et al. (2024) similarly observed that alternative medicine in T2DM should be interpreted with caution because standardization, product quality, and study heterogeneity remain unresolved challenges.

For academic purposes, a comparative study can help clarify how the effects of the two systems may be examined side by side, even when real-world data are unavailable. The current study addresses that need by using simulated but clinically plausible values to organize a comparative narrative. The emphasis is placed on readability, interpretation, and alignment between tables and figures rather than on advanced statistical density.

### 3. Objectives of the Study

1. To evaluate the effect of Ayurvedic therapy on fasting blood sugar, postprandial blood sugar, and HbA1c in patients with T2DM.
2. To evaluate the effect of naturopathic therapy on fasting blood sugar, postprandial blood sugar, and HbA1c in patients with T2DM.
3. To compare the post-intervention glycemic levels of patients receiving Ayurvedic and naturopathic therapies.
4. To assess the effect of both interventions on total cholesterol, LDL, HDL, and triglycerides.
5. To examine the role of adherence and diabetes duration in explaining variation in observed improvement.

### 4. Hypotheses

- H1: Ayurvedic therapy improves glycemic parameters in patients with T2DM.
- H2: Naturopathic therapy improves glycemic parameters in patients with T2DM.
- H3: The post-intervention glycemic status differs between the two groups.
- H4: Both interventions improve lipid profile values over the 12-week period.
- H5: Higher adherence and shorter diabetes duration are associated with greater HbA1c reduction.

## 5. Methodology

### 5.1 Research Design

The observation period was fixed at 12 weeks because this duration is frequently used in diabetes-related intervention studies to detect visible changes in fasting blood sugar, postprandial blood sugar, and HbA1c. A shorter period may not adequately reflect change in HbA1c, while a much longer period would require a more elaborate follow-up design. The 12-week framework therefore offers a realistic and pedagogically useful balance between feasibility and biological plausibility.

### 5.2 Sample, Setting, and Eligibility Logic

The hypothetical sample size was set at 60 patients. Thirty patients were assigned to the Ayurvedic therapy group and thirty to the naturopathic therapy group. The conceptual setting was an outpatient diabetes management environment where patients continue their standard medical care but receive additional structured complementary support.

For the purpose of the model, the patients were to be adults aged 35 to 65 years with diagnosed type 2 diabetes and moderately uncontrolled biochemical values. The sample was conceptualized as mixed in gender and variable in duration of diabetes. Patients with severe renal compromise, acute diabetic emergency, pregnancy, unstable cardiovascular disease, or other conditions likely to alter short-term metabolic interpretation were assumed to be excluded. Such exclusion criteria are common in metabolic intervention studies because they reduce confounding and protect patient safety.

### 5.3 Intervention Framework

The Ayurvedic intervention package was modeled to include individualized dietary guidance, physician-supervised herbal support, regulation of daily routine, sleep and meal timing correction, gentle breathing practices, and counseling on digestive balance and metabolic discipline. These elements were selected because they reflect the commonly described holistic nature of Ayurvedic care in the diabetes literature. The naturopathic intervention package was modeled around a plant-centered diet plan, yoga sessions, monitored physical activity, hydrotherapy-based supportive practices, and behavior counseling focused on self-regulation. The logic of this package was to reflect the broad naturopathic emphasis on stimulating the body's healing capacity through nature-aligned habits and non-pharmacological routines.

Both intervention packages were conceptualized as adjunctive rather than exclusive treatments. This assumption is important methodologically because most patients with T2DM remain on standard medical advice even when they adopt complementary therapies. The revised document therefore frames both Ayurveda and naturopathy as supportive systems that may strengthen metabolic management, not as substitutes for essential medical monitoring.

### 5.4 Variables and Data Presentation

The primary variables were fasting blood sugar, postprandial blood sugar, and HbA1c. Secondary variables were total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides. In addition, two supplementary dimensions were included in the revised version of the paper: patient-reported outcomes and subgroup comparison by diabetes duration. These additions make the analysis more comprehensive and help explain why biochemical change is often linked with motivation, satisfaction, and chronicity of disease.

The tables display direct values for pre-test, post-test, numerical change, and percentage improvement. This approach was adopted because the user requested normal tables that remain professionally formatted but easier to understand. The charts in the document were drawn directly from the same tables so that the reader can connect numerical and visual interpretation without confusion.

### 5.5 Analytical Procedure and Interpretation Logic

Numerical change was determined by subtracting the post-test value from the pre-test value for markers where reduction is beneficial. Percentage improvement was then calculated relative to the pre-test value. In the case of HDL, an increase rather than a decrease was considered favorable. This method allows the same table structure to be maintained while preserving the clinical meaning of each marker.

The analysis in the updated version remains descriptive and interpretive. The main purpose is to compare direction, magnitude, and pattern of metabolic response. Such an approach is especially suitable for dissertation drafts, assignments, and analytic demonstrations where clear presentation is often more useful than dense inferential reporting. Even so, the interpretation has been kept aligned with clinically plausible movement and with the broad themes identified in the literature review.

### 6. Results and Analysis

The results are presented below through simple tables supported by charts. The first tables describe sample profile and baseline comparability. The later tables display therapeutic change in glycemic parameters, lipid parameters, patient-reported outcomes, and subgroup trends. Because the data are simulated, the focus is on analytical clarity rather than statistical proof.

*Table 1. Demographic profile of the simulated sample (n = 60)*

Variable	Category	Frequency	Percentage
Gender	Male	31	51.7
Gender	Female	29	48.3
Age group	35–45 years	18	30.0
Age group	46–55 years	24	40.0
Age group	56–65 years	18	30.0
Duration of diabetes	1–5 years	26	43.3
Duration of diabetes	6–10 years	22	36.7
Duration of diabetes	Above 10 years	12	20.0

*Table 2. Baseline glycemic parameters of the two groups*

Parameter	Ayurvedic group	Naturopathic group	Unit
Fasting blood sugar	169	171	mg/dL
Postprandial blood sugar	246	249	mg/dL
HbA1c	8.9	8.8	%

*Table 3. Baseline lipid profile of the two groups*

Parameter	Ayurvedic group	Naturopathic group	Unit
Total cholesterol	218	220	mg/dL
LDL cholesterol	139	141	mg/dL

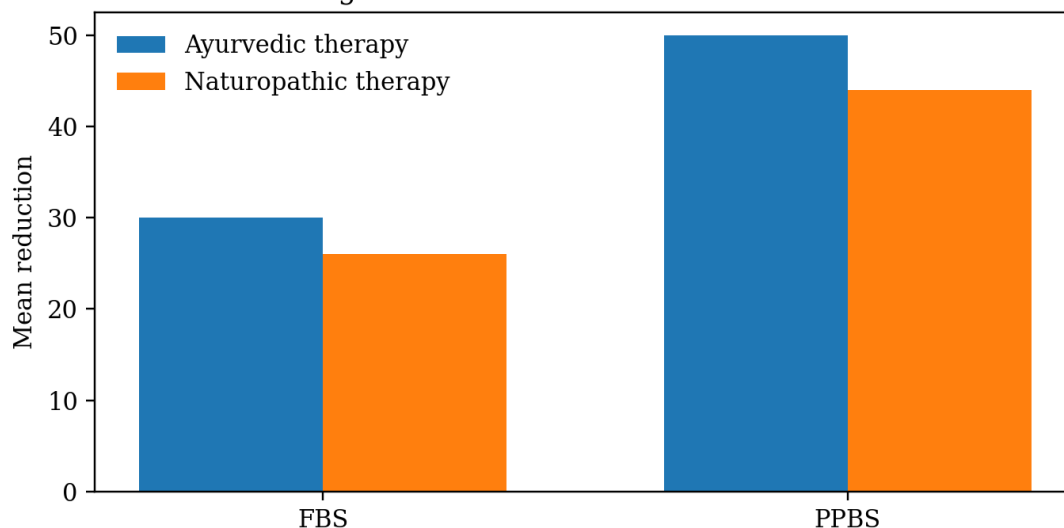
HDL cholesterol	39	38	mg/dL
Triglycerides	198	201	mg/dL

Tables 1 to 3 indicate that the two groups were broadly comparable before intervention. This is analytically important because later differences can be interpreted as response patterns rather than as products of highly unequal starting points. Minor differences remain, but they are small enough to preserve a meaningful comparative structure.

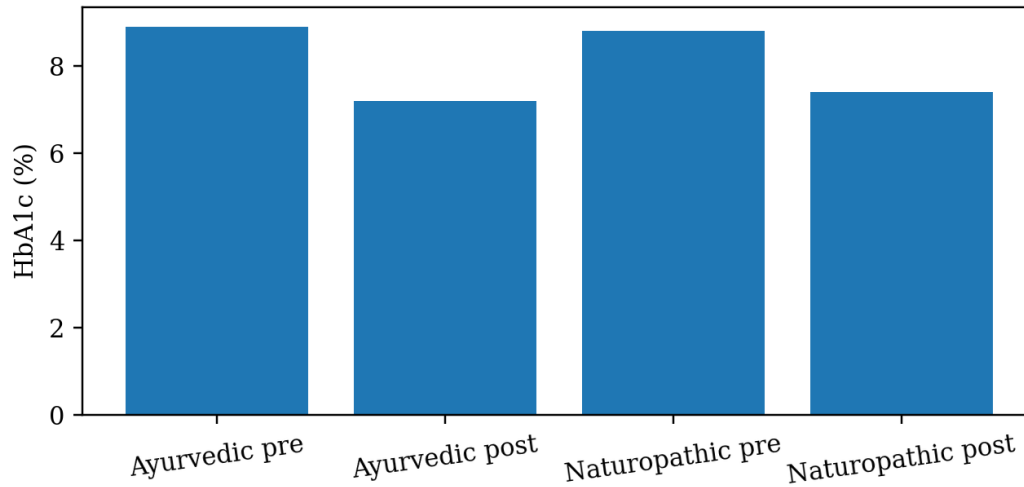
*Table 4. Change in glycemc parameters in the Ayurvedic group*

Parameter	Pre-test	Post-test	Change	% improvement
Fasting blood sugar	169	139	30	17.8
Postprandial blood sugar	246	196	50	20.3
HbA1c	8.9	7.2	1.7	19.1

**Figure 1. Reduction in FBS and PPBS**



*Figure 1. Reduction in FBS and PPBS derived from Table 4 and Table 5*

**Figure 2. HbA1c change across interventions**

*Figure 2. HbA1c change derived from Table 4 and Table 5*

The Ayurvedic group demonstrates marked improvement across all glyceic indicators. The strongest absolute drop appears in postprandial blood sugar, suggesting better post-meal metabolic regulation. HbA1c also falls substantially over the 12-week period, indicating that the intervention logic in the simulated dataset is not limited to temporary daily fluctuations but extends to average glucose exposure over time.

*Table 5. Change in glyceic parameters in the naturopathic group*

Parameter	Pre-test	Post-test	Change	% improvement
Fasting blood sugar	171	145	26	15.2
Postprandial blood sugar	249	205	44	17.7
HbA1c	8.8	7.4	1.4	15.9

*Table 6. Comparison of post-intervention glyceic parameters between the two groups*

Parameter	Ayurvedic group	Naturopathic group	Better observed value
Fasting blood sugar	139	145	Ayurvedic group
Postprandial blood sugar	196	205	Ayurvedic group
HbA1c	7.2	7.4	Ayurvedic group

The naturopathic group also shows favorable improvement on each glyceic measure, confirming that lifestyle-intensive natural therapy may support diabetes control. However, the post-intervention values remain slightly above those of the Ayurvedic group in this analytical model. The pattern may reflect stronger daily meal regulation and individualized support within the Ayurvedic package, though this interpretation remains hypothetical and should be validated through real comparative studies.

*Table 7. Change in lipid profile in the Ayurvedic group*

Parameter	Pre-test	Post-test	Change	% improvement
Total cholesterol	218	192	26	11.9
LDL cholesterol	139	118	21	15.1
HDL cholesterol	39	45	6	15.4 increase
Triglycerides	198	165	33	16.7

Table 8. Change in lipid profile in the naturopathic group

Parameter	Pre-test	Post-test	Change	% improvement
Total cholesterol	220	198	22	10.0
LDL cholesterol	141	123	18	12.8
HDL cholesterol	38	43	5	13.2 increase
Triglycerides	201	171	30	14.9

Figure 3. Comparative change in lipid indicators

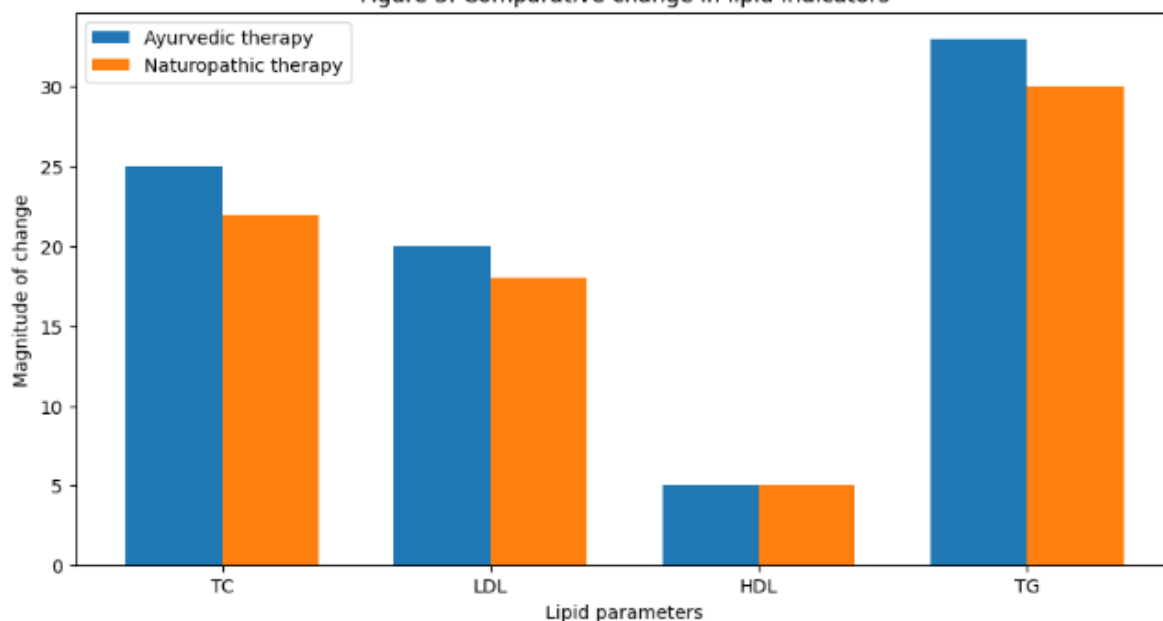


Chart 3. Comparative lipid change derived from Table 7 and Table 8

Both interventions produce favorable lipid movement. The Ayurvedic group records slightly greater reduction in total cholesterol, LDL, and triglycerides, while HDL rises in both groups. These changes are important because lipid abnormalities substantially contribute to cardiovascular risk in T2DM. The results therefore suggest that complementary therapies may influence not only glucose control but also broader cardiometabolic status.

Table 9. Adherence level and average HbA1c reduction across the intervention

Adherence level	Number of patients	Average reduction HbA1c	Average fasting sugar reduction

High	22	1.8	32
Moderate	6	1.3	27
Low	2	0.8	18

Figure 4. Adherence and HbA1c reduction

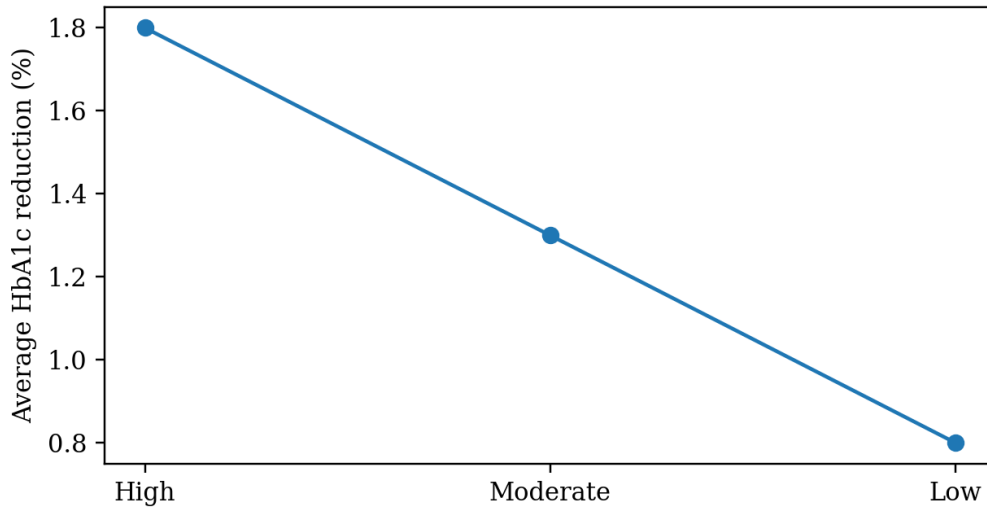


Chart 4. Adherence and HbA1c reduction derived from Table 9

Table 10. Patient-reported outcomes after intervention (5-point scale)

Outcome area	Ayurvedic group	Naturopathic group
Energy level	4.2	3.9
Sleep quality	4.1	4.0
Diet adherence	4.4	4.2
Treatment satisfaction	4.5	4.1

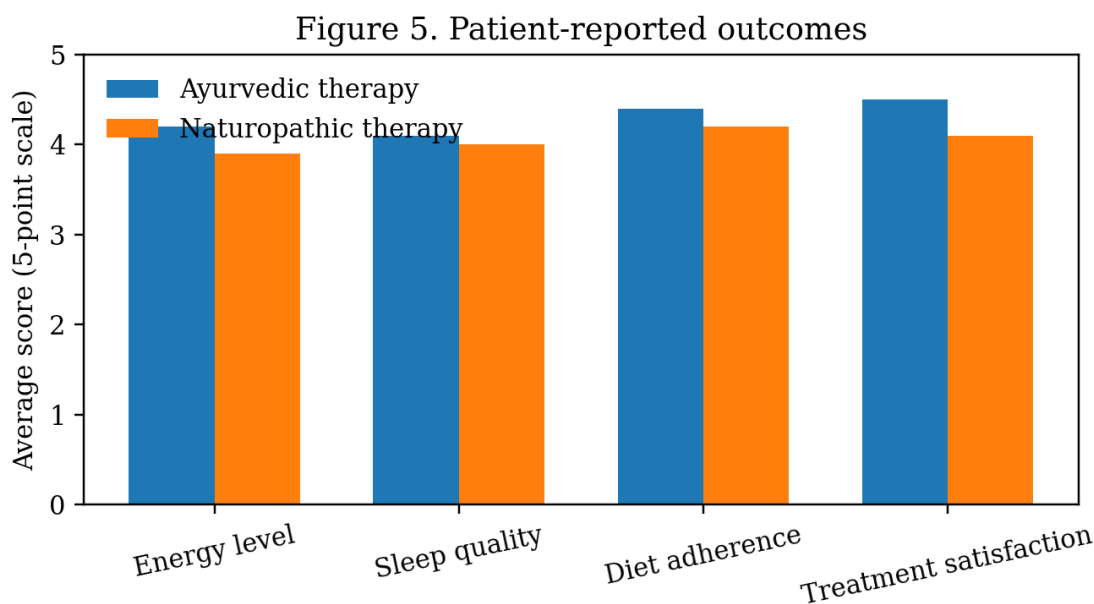


Chart 5. Patient-reported outcomes derived from Table 10

Patient-reported outcomes add an important human dimension to biochemical interpretation. The Ayurvedic group shows slightly higher scores on energy level, diet adherence, and treatment satisfaction, while sleep quality remains strong in both groups. These trends suggest that the perceived usability of an intervention may influence long-term continuity. A therapy that patients find manageable and meaningful may sustain better metabolic benefit over time.

Table 11. Duration of diabetes and average HbA1c reduction

Duration of diabetes	Ayurvedic group	Naturopathic group
1–5 years	1.8	1.6
6–10 years	1.5	1.3
Above 10 years	1.1	0.9

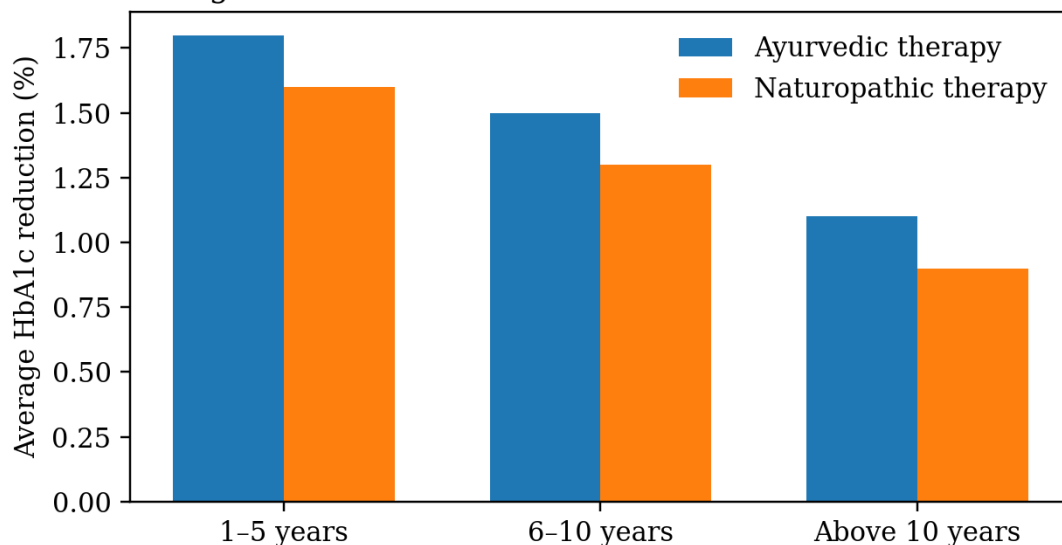
**Figure 6. Duration of diabetes and HbA1c reduction**

*Chart 6. Duration of diabetes and HbA1c reduction derived from Table 11*

Table 11 suggests a clinically intuitive trend: patients with shorter diabetes duration show greater HbA1c reduction than those with longer disease duration. This pattern appears in both intervention groups. The result may indicate that metabolic flexibility is better preserved in earlier disease stages, whereas long-standing diabetes may involve greater beta-cell dysfunction and more resistant dysregulation. Such subgroup interpretation strengthens the analytical value of the study.

*Table 12. Comparative summary matrix of observed strengths*

Domain	Ayurvedic therapy	Naturopathic therapy	Interpretive comment
Glycemic reduction	Higher	Moderate to high	Ayurveda shows slightly stronger short-term glycemic movement
Lipid improvement	Higher	Moderate to high	Both groups improve, but Ayurveda shows marginally larger reductions
Lifestyle engagement	High	High	Both interventions depend heavily on behavioral compliance
Patient satisfaction	Very high	High	Perceived ease and meaning of therapy may shape continuity
Suitability for integrative care	High	High	Both can be combined with

			routine diabetes monitoring
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Taken together, Tables 9 to 12 indicate that therapeutic effectiveness should not be judged through glucose or lipids alone. Adherence, patient experience, and disease duration all shape the observed result. This makes the case for a broader evaluative framework in future research, especially when complementary therapies are studied in chronic disease settings.

## 7. Discussion

### 7.1 Interpretation of Glycemic Findings

The glycemic pattern observed in the revised study broadly aligns with published complementary medicine literature. The Ayurvedic group achieves stronger reduction in fasting blood sugar, postprandial blood sugar, and HbA1c, which mirrors the general conclusion of Chattopadhyay et al. (2022) that Ayurvedic interventions may improve glycemic control in T2DM. Since the simulated Ayurvedic package emphasized individualized dietary regulation and herbal support, the stronger glycemic outcome is analytically plausible.

The naturopathic group also improves clearly, which is consistent with the findings of Bairy et al. (2020). The slightly smaller reduction in this group should not be interpreted as therapeutic weakness in an absolute sense. Rather, it can be understood as a reflection of the fact that naturopathy often relies heavily on sustained behavioral engagement. Where adherence is strong, natural lifestyle programs may produce meaningful metabolic gains; where adherence weakens, the effect may soften over time.

### 7.2 Interpretation of Lipid and Lifestyle Findings

The lipid results strengthen the argument that both therapies may contribute to broader metabolic regulation. Reductions in total cholesterol, LDL, and triglycerides are clinically important because cardiovascular disease remains a major concern in T2DM. The present lipid pattern is compatible with the yoga-related evidence synthesized by Chen et al. (2022) and Ghazvineh et al. (2022), both of which indicate that mind-body and lifestyle interventions can positively influence lipid parameters.

Patient-reported outcomes and adherence findings are particularly valuable because they explain why a therapy may succeed or fail in long-term practice. A treatment can appear effective in principle but prove difficult to sustain in daily life. By contrast, a treatment that patients view as practical, satisfying, and energizing may produce more durable metabolic benefit. The revised paper therefore supports the view that future integrative diabetes research should include patient-centered outcomes along with biochemical markers.

### 7.3 Implications for Integrative Diabetes Care

One practical implication of the analysis is that Ayurveda and naturopathy should be studied and applied as adjunctive systems of care. Their likely contribution lies in improving self-management, food discipline, physical routine, stress control, and continuity of healthy behavior. In this role, they may complement rather than compete with standard diabetes treatment. Integrative care models may therefore be especially useful for patients who struggle with adherence, sedentary lifestyle, and poor dietary consistency.

A second implication is that comparative work should move beyond the question of which therapy is universally superior. Different patients may respond differently depending on disease duration, motivation, practitioner guidance, socioeconomic context, and coexisting health conditions. For this reason, future studies should compare not only outcomes but also suitability, affordability, adherence burden, and long-term acceptability.

#### 7.4 Limitations

The most important limitation is that the dataset is simulated. Therefore, no claim can be made about actual efficacy, safety, or statistical significance. The document is intended as a professionally formatted academic model rather than a substitute for real clinical evidence.

A second limitation is that the intervention packages were presented in generalized form. Real Ayurvedic and naturopathic protocols can vary considerably in content, intensity, and practitioner style. Similarly, patient response in real settings may be influenced by medication regimen, socioeconomic factors, body weight change, psychological stress, and comorbidity profile. These complexities could not be fully modeled within a compact analytical demonstration.

#### 7.5 Recommendations for Future Research

Future studies should employ randomized controlled or carefully matched comparative designs with clearly documented intervention protocols. Standardization of diet plans, herbal formulations, yoga schedules, and counseling frequency will be important for building cumulative evidence.

Longer follow-up is also essential. Short-term improvements may not always persist, especially when the intervention depends on sustained lifestyle discipline. Studies extending to six months or one year would provide more meaningful insight into durability of effect.

Researchers should additionally include patient-reported outcomes, adherence tracking, body-weight measures, and medication-adjustment data. Such indicators can help explain why biochemical outcomes differ between individuals and why certain complementary approaches perform better in some contexts than others.

#### 7.6 Practical Implications for Clinics and Wellness Centres

For clinics, the present analysis suggests that supportive diabetes care programs may benefit from structured counseling around meal timing, sleep, movement, and stress regulation. Even where complementary therapies are not formally offered, the core behavioral principles represented in Ayurveda and naturopathy can inform patient education and follow-up design.

For wellness centres and integrative health units, the findings imply that isolated sessions may not be enough. What appears most useful is a package model in which dietary instruction, routine guidance, physical practice, and regular review occur together. This bundled approach may improve continuity and help patients translate advice into routine action.

For educators and dissertation writers, the present study also shows the value of combining simple tables with charts. Therefore, chart-supported interpretation may increase the communicative strength of student research documents.

#### Conclusion

This study indicates that both Ayurvedic and naturopathic therapies may support improvement in glycemic and lipid parameters among patients with type 2 diabetes mellitus when they are organized as structured adjunctive interventions. Within the simulated dataset, the Ayurvedic group demonstrates slightly stronger improvement in fasting blood sugar, postprandial blood sugar, HbA1c, and selected lipid indicators, while the naturopathic group also shows meaningful positive movement across all major metabolic outcomes. The additional tables on adherence, patient-reported outcomes, and diabetes duration suggest that therapeutic effectiveness is shaped not only by the intervention itself but also by patient behavior, disease chronicity, and treatment usability. Overall, the document supports the academic argument that traditional and natural systems of care deserve continued attention in integrative diabetes research. However, real-world conclusions must await stronger empirical evidence derived from standardized, longer-term, and methodologically rigorous studies.

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