

Physical Activity and Complementary Lifestyle Interventions in Diabetes Management: An Integrative Review of Exercise, Yoga, Nutrition, Herbal Therapies, and Reflexology

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ABSTRACT:

Background: Physical activity has long been central to diabetes care, while yoga, dietary modification, medicinal plants, and reflexology have frequently been proposed as complementary approaches. This article evaluates these modalities against contemporary evidence.

Methods: A structured integrative review was undertaken in September 2026. PubMed/MEDLINE-indexed literature and current guidance and epidemiological data from the American Diabetes Association (ADA), World Health Organization, and International Diabetes Federation were examined. Priority was given to guidelines, randomized trials, systematic reviews, and meta-analyses.

Results: Exercise remains the most consistently supported non-pharmacological intervention. Current ADA guidance recommends at least 150 min/week of moderate-to-vigorous aerobic activity for most adults with diabetes plus resistance exercise 2-3 times/week. Modern meta-analyses confirm clinically meaningful HbA1c reductions, with benefits varying by baseline glycaemia, dose, and modality. Yoga appears useful as an adjunct but is limited by heterogeneity and risk of bias. Individualized medical nutrition therapy is strongly supported, whereas evidence for herbal products is product-specific and inconsistent. Reflexology may reduce diabetic neuropathic pain but should not be presented as a glucose-lowering therapy.

Conclusion: The principal academic contribution is a tiered evidence framework that distinguishes core therapies, promising adjuncts, investigational products, and symptom-oriented complementary care, aligning clinical interpretation with 2026 evidence and contemporary standards of diabetes management.

KEYWORDS: Diabetes mellitus; physical activity; exercise therapy; yoga; medical nutrition therapy; herbal medicine

1. Introduction

The increasing number of people worldwide affected by diabetes mellitus makes it one of the largest and most pressing public health issues globally. As of 2024, the IDF estimates that approximately 589 million adults 20-79 years old have diabetes, or about 11.1% of all adults within this age group, and anticipates around 853

million cases by 2050 (International Diabetes Federation [IDF], 2025). The WHO also considers diabetes a leading cause of blindness, kidney failure, cardiovascular disease, stroke, and lower-limb amputations. It further emphasizes the importance of a healthy diet, regular physical activity, maintaining ideal weight, abstaining from smoking, using medications appropriately when needed, and getting screened for

complications to prevent and manage diabetes (World Health Organization [WHO], 2024). As a result of the growing burden associated with diabetes, there has been increased emphasis placed upon developing evidence-based non-pharmacological approaches that can provide additional support for pharmacotherapies, monitoring, and complication prevention.

There are numerous categories of non-pharmacological methods of managing diabetes, which include but are not limited to structured forms of physical activity, various forms of mind-body exercises such as yoga, medical nutrition therapy, medicinal plants, and other types of complementary/supportive practices such as reflexology. A well-established physiological rationale supports the use of exercise to treat diabetes. Specifically, active skeletal muscle is able to increase the rate at which glucose is utilized. Additionally, frequent engagement in regular activities can improve insulin sensitivity, body composition, cardiovascular function, and overall mental/psychological well-being. Each category of treatment modality used to address diabetes is supported by significantly varying amounts of evidence. There exists a significant amount of evidence supporting the prescription of exercise based on a substantial number of randomized trials and subsequent meta-analysis studies; there is evidence that nutrition guidance should focus on providing individuals with personalized recommendations regarding their intake of nutrient-dense food patterns; and finally, there is evidence demonstrating that certain complementary treatments may serve as effective adjuncts to standard care provided for diabetes, whereas others may possess unproven efficacy as adjuncts to standard care provided for diabetes and yet still others may be ineffective in improving glycemic control.

In addition to landmark evidence, there have been many studies on yoga and its effects on the body's metabolism. Knowler et al. (2002) conducted the Diabetes Prevention Program (DPP) and demonstrated a 58% relative decrease in developing type 2 diabetes through intensive lifestyle modifications compared to those receiving placebo treatments for an average duration of approximately two years. Subsequent research examining early yoga also identified potentially beneficial metabolic outcomes. In their study, Gordon

et al. (2008) noted significant decreases in participants' fasting blood glucose levels following six months of Hatha yoga practice or conventional physical training. Additionally, Chaya et al. (2008) found that long-term yoga practitioners had higher degrees of insulin sensitivity than their matched counterparts who did not engage in regular yoga practice. As such, these studies are now part of a much larger body of evidence that will allow researchers to evaluate the magnitude of the positive effects of various non-pharmacological and complementary interventions, along with evaluating the risk of bias associated with each intervention, and ultimately determine which interventions can be generalized to clinical settings.

Therefore, the research question being evaluated in this paper is not whether lifestyle changes matter in terms of preventing diabetes, since it is already well established by previous research, but rather how different forms of non-pharmacological and complementary therapies rank based upon current evidence. The risk of treating all modalities equally lies in equating evidence-based treatment recommendations with guidelines for adjunctive or insufficiently tested forms of therapy. Alternatively, the risk of completely dismissing all complementary therapies exists because research indicates that some of them, including yoga as a specific form of physical activity and others focused on managing symptoms, can provide clinically relevant benefits when implemented safely in conjunction with standard care.

Accordingly, this study has four objectives. The first is to review current evidence about physical activity and diabetes. The second is to review the current evidence on yoga, nutrition, medicinal herbs, and reflexology. The third is to differentiate the evidence that is strong from that which requires qualification or remains ambiguous. Fourth, it proposes a tiered evidence framework for incorporating non-pharmacological interventions into person-centered diabetes management. It primarily addresses type 2 diabetes because most studies have focused on that population while continuing to include some safety issues related to type 1 diabetes.

2. Literature Review and Conceptual Background

Exercise has numerous effects on the body that are important for managing and treating diabetes. The

immediate effect of a bout of exercise is an increase in glucose entry into the muscles through non-insulin-dependent pathways. Regular bouts of exercise can improve the way the body uses insulin, mitochondrial function, heart and lung function, blood vessel function, and fat mass. As such, the World Health Organization (WHO) advocates for individuals with chronic diseases (including type 2 diabetes) to perform at least 150–300 minutes per week of moderate-intensity physical activity or 75–150 minutes per week of vigorous-intensity physical activity, as well as to include muscle-strengthening activities on at least two days each week (WHO, 2020). The 2022 American College of Sports Medicine (ACSM) consensus statement concluded that regular aerobic and resistance exercise improves glycaemic control and broader cardiometabolic health in people with type 2 diabetes, while reducing sedentary time and interrupting prolonged sitting are also beneficial (Kanaley et al., 2022). The ADA Standards of Care in Diabetes-2026 similarly recommend routine assessment of physical activity and sedentary time, at least 150 min/week of moderate-to-vigorous aerobic activity for most adults with diabetes, and resistance exercise on 2-3 nonconsecutive days per week (American Diabetes Association Professional Practice Committee for Diabetes [ADA PPC], 2026).

Evidence has also moved from asking whether exercise works to asking which dose and modality are most useful. Gallardo-Gómez et al. (2024) synthesized 126 studies including 6,718 participants and estimated an optimal weekly dose near 1,100 MET-min/week, with larger absolute HbA1c reductions among people with poorer baseline glycaemic control. Liang et al. (2024), using 85 randomized trials and 5,535 participants, reported HbA1c reductions across high-intensity interval training, combined aerobic and resistance exercise, yoga, and continuous aerobic exercise, but emphasized that certainty for comparative ranking was low. More contemporary reviews also support wide-ranging positive outcomes for all types of exercise and indicate that supervised programs with volumes at guideline target levels can result in improved glycemic control as well as improved cardiovascular risk factors (Michielsen et al., 2026). Therefore, in practice, rather than statistically selecting the best modality to prescribe for a client, the modality should be prescribed based on the preferences of the client.

The position of yoga is between traditional forms of exercise and complementary mind-body therapies. Early clinical trial results suggested that practicing Hatha yoga resulted in improvements in fasting plasma glucose levels, lipid profiles, oxidative stress, and general well-being. After six months of practice, Gordon et al. (2008) found a 29.48 percent decrease in fasting blood glucose levels in the Hatha yoga group compared to a 27.43 percent decrease in the conventional physical-training group. The majority of more recent systematic reviews have supported this trend with the caveat of being much more conservative. Vijay et al. (2025) conducted a systematic review of 14 randomized controlled trials consisting of 1,876 total participants, which demonstrated that three months of practicing yoga decreased HbA1c values by 0.55 percentage points, decreased fasting glucose values by 24.72 mg/dL, and decreased postprandial glucose values by 26.01 mg/dL. Although the heterogeneity in these results was substantial and most studies included in the review exhibited a high level of bias due to methodology (Vijay et al., 2025), the authors published a 2026 correction for Figures 4 through 8 (Vijay et al., 2026). Thus, yoga is reasonable as an adjunctive activity, particularly when it improves adherence, flexibility, stress management, or accessibility, but it should not displace evidence-based exercise, nutrition, medication, or monitoring.

Dietary treatment continues to play an important role in managing type 2 diabetes. The current American Diabetes Association (ADA) Position Paper on Nutrition Therapy has significantly changed its approach to dietary management by moving away from recommending specific percentages of carbohydrates, proteins, and fats as optimal for individuals with diabetes. Rather than recommend specific ratios, the ADA recommends using medical nutrition therapy based upon metabolic goals, dietary preferences, culture, access, and comorbid conditions. In addition, it emphasizes consuming a variety of nonstarchy vegetables, whole fruits, legumes, lean protein sources, whole-grain products, nuts, and seeds and limiting consumption of sugar-sweetened beverages, refined grains, and processed foods (American Diabetes Association Professional Practice Committee, 2026).

More recently, a meta-analysis comparing results of

randomized controlled trials (RCTs) demonstrated that adherence to a Mediterranean-style diet resulted in significant reductions in mean HbA1c levels, fasting glucose levels, body mass index (BMI), and some cardiovascular disease risk-factor measures compared with control groups (Wu et al., 2025).

Adherence to low-carbohydrate diets has been shown to result in improvements in mean HbA1c levels in some individuals with diabetes, particularly when measured over shorter time frames. However, similar to other studies examining the effects of low-carbohydrate diets, the overall improvement in HbA1c values appears to be relatively small and diminishes over longer periods of time. It is difficult to compare the findings of these different studies because they used varying definitions of low-carbohydrate diets and reported different levels of adherence to their respective study-defined diets (Beretta et al., 2025; Mongkolsucharitkul et al., 2025).

Medicinal plants require the greatest evidentiary caution. Products commonly proposed for glycaemic management include cinnamon, fenugreek, *Gymnema sylvestre*, *Momordica charantia*, *Aloe vera*, *Coccinia indica*, *Atriplex halimus*, *Poterium spinosum*, and others. For several products, earlier support relied mainly on animal data or small clinical studies. This distinction is important. For example, the widely cited 2003 cinnamon trial reported improvements in fasting glucose and lipids, but the American Diabetes Association issued an expression of concern regarding that article in 2025 (American Diabetes Association, 2025; Khan et al., 2003). There are indications in more recent cinnamon meta-analyses that may be indicative of positive glycemic effects; however, they have also

indicated a degree of heterogeneity and variation in products (Moridpour et al., 2024; Bakhach et al., 2024).

The pooled clinical evidence for fenugreek has been relatively more consistent; specifically, a 2024 meta-analysis demonstrated improvements in fasting glucose and HbA1c levels, although there was some variation in preparations, dosages, and study quality (Vajdi et al., 2024). However, the *Gymnema* meta-analysis has indicated some favorable glycemic signals; however, due to extremely high heterogeneity, confidence is limited (Devangan et al., 2021). Contemporaneous meta-analyses for bitter melon indicate conflicting results regarding whether bitter melon lowers blood glucose/HbA1c levels. One meta-analysis determined that bitter melon lowered both fasting glucose and HbA1c levels (Zhang et al., 2024), whereas another placebo-controlled meta-synthesis indicated that there was no compelling evidence that bitter melon had a clinically significant effect on metabolism (Laczkó-Zöld et al., 2024). These conflicting findings support an investigational rather than a routine clinical status.

The concept of reflexology differs from other glucose-lowering treatments. Current evidence is specific: a 2026 meta-analysis of eight trials with a total of 590 patients demonstrated that reflexology massage significantly decreased neuropathic pain and increased quality of life in patients with diabetic neuropathic pain (Topal et al., 2026). It does not appear that these studies established changes in HbA1c, insulin sensitivity, or diabetes progression. Therefore, reflexology can best be described as a symptom-oriented supportive therapy and should not be considered a glucose-lowering therapy.

Table 1. Evidence classification of non-pharmacological and complementary interventions in diabetes management

Domain	Established premise / rationale	Contemporary reassessment	Current classification
Physical activity	Central therapeutic and preventive strategy; improves glucose use, insulin sensitivity, cardiovascular function, weight, and well-being.	Strongly confirmed by ADA/ACSM guidance and large meta-analyses. Dose, modality, baseline HbA1c, medications, and complications influence response.	Core evidence-based therapy
Yoga	Mind-body exercise proposed to improve glucose regulation, lipids, oxidative stress, flexibility, and well-being.	Meta-analyses support glycaemic benefit, but heterogeneity and risk of bias remain substantial. Best viewed as an adjunctive activity.	Promising adjunct
Nutrition	Dietary quality, energy balance, and weight management are central components of metabolic control.	Core role confirmed, but modern guidance emphasizes individualized medical nutrition therapy and overall diet quality rather than one universal macronutrient prescription.	Core evidence-based therapy
Medicinal plants	Several plant products have been proposed as glucose-lowering adjuncts based on traditional use, preclinical evidence, or small trials.	Evidence is product-specific and inconsistent; some older claims relied on animal data or small trials. No product should replace established therapy.	Investigational / uncertain
Reflexology	Complementary manual therapy proposed primarily for supportive or symptom-oriented benefits.	Evidence now supports possible reduction in neuropathic pain and improvement in quality of life, not established glycaemic control.	Symptom-oriented supportive care

3. Methodology

This study was designed as a structured integrative review to investigate five specified domains: (1) physical activity/exercise; (2) yoga; (3) nutritional interventions; (4) herbal/medicinal plant treatments; and (5) reflexology. The rationale for selecting these domains

was based on comparing well-established lifestyle intervention strategies with those that are more commonly referenced as complementary treatment options to evaluate how each is utilized within a contemporary clinical setting according to the strength and quality of current research evidence.

A literature search was completed in September 2026. Literature searches included peer-reviewed articles indexed through MEDLINE/PubMed, clinical guidelines developed by the World Health Organization (WHO), American Diabetes Association (ADA), and International Diabetes Federation (IDF), along with epidemiological data. A combination of search terms related to "diabetes," "type 2 diabetes," "physical activity," "aerobic exercise," "resistance exercise," "combined exercise," "high-intensity interval training," "yoga," "medical nutrition therapy," "Mediterranean diet," "low-carbohydrate diet," "cinnamon," "fenugreek," "*Gymnema sylvestre*," "*Momordica charantia*," "reflexology," "diabetic neuropathy," "systematic review," "meta-analysis," "randomized controlled trial," "clinical practice guideline," and "consensus statement" was used to identify publications from 2020 to 2026, while landmark publications prior to 2020 that continued to have clinical significance were also included.

A wide variety of eligible evidence existed for inclusion in the review. These included current clinical practice guidelines and/or consensus statements, randomized or controlled trials in humans, systematic reviews, meta-analyses, and large-scale prospective studies of lifestyle interventions. However, evidence derived solely from animal studies was not utilized to support the development of clinical recommendations, although such evidence was considered to clarify the translational limits of herbal claims. As opposed to statistical synthesis of studies, narrative synthesis was employed, as there was no need for a new meta-analysis. Due to the nature of this being an integrative review, versus a formal GRADE evaluation, the certainty categories are qualitative and based upon the degree to which the clinical recommendation has been endorsed

by current clinical guidelines, the quality of the study design(s) examined, the extent to which results have been replicated, the number of subjects studied, the consistency of results across all included studies, and the relevance/applicability of results to the target population. The above-referenced certainty categories for interpreting the strength of evidence for various modalities include: core evidence-based therapy, promising adjunct, investigational/uncertain, and symptom-oriented supportive care.

Data extraction was concentrated on the nature of interventions; target populations; treatment durations; the major glycemic outcomes; the direction and magnitude of the effects of the interventions; the major limitations; and their current clinical significance. Each claim was then categorized according to whether it was very well supported for use, needed clarification/qualification due to inadequate evidence, or simply lacked sufficient scientific evidence to support claims as a disease-modifying treatment.

4. Results

A distinct division was seen in the results across intervention groups. Exercise is fundamental to both the prevention and treatment of diabetes and is clearly outlined in current standards. Enough research now exists that yoga should be considered as an adjunct to either regular exercise or other forms of mind-body training; however, the overall magnitude of effects varies significantly. Signals exist among specific herbal products, but there is no consistency with regard to reproducibility or standardization across products. Rather than glycemic control, reflexology seems to have some evidence supporting improved quality of life and decreased neuropathic pain. This evidence structure is summarized in Figure 1.

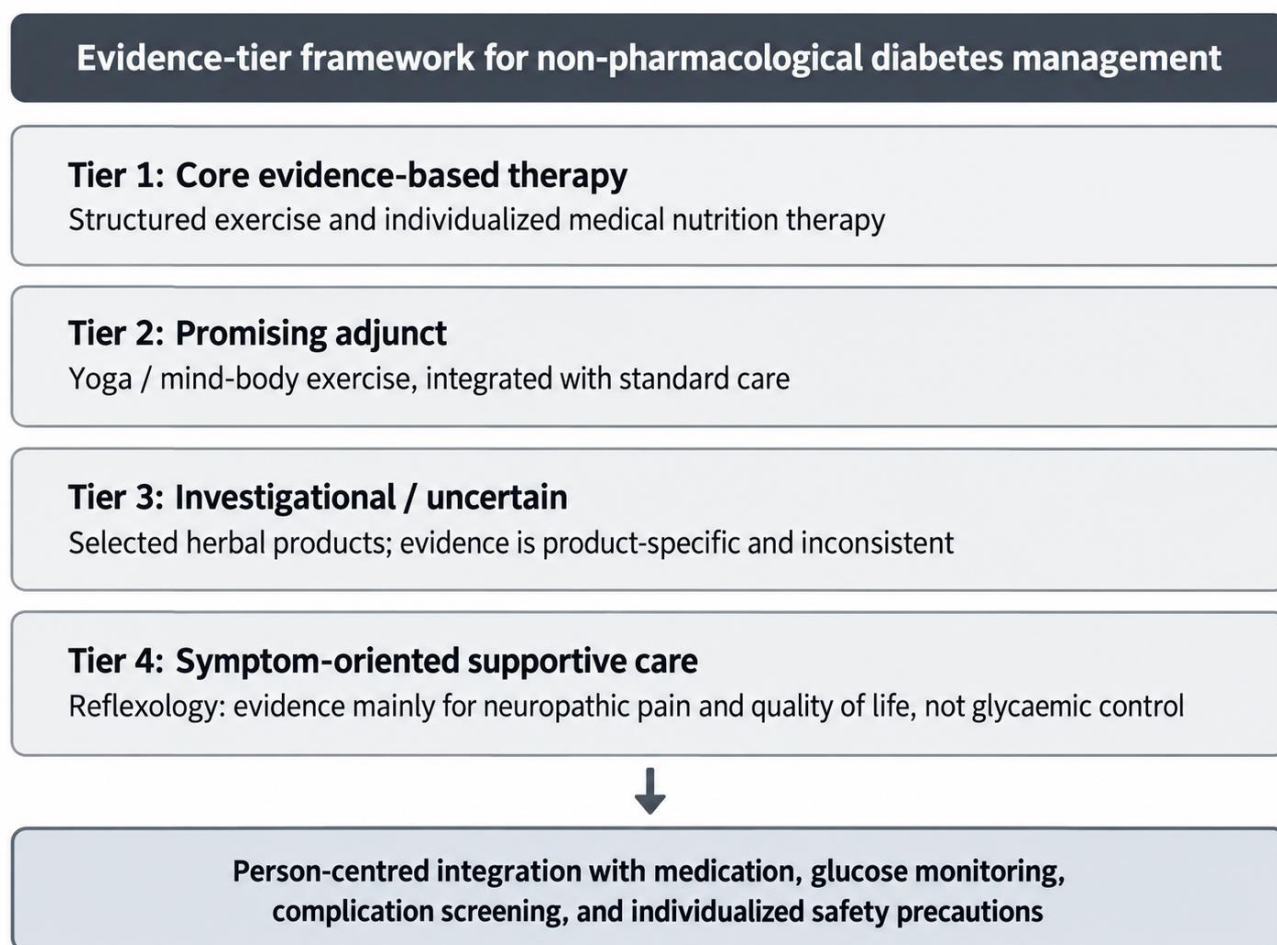


Figure 1. Evidence-Tier Integration Framework for non-pharmacological and complementary interventions in diabetes management.

Physical activity has generated the largest number of findings that are consistent and strong. The Diabetes Prevention Program (DPP) continues to be an important prevention trial: there were 11.0, 7.8, and 4.8 cases of diabetes per 100 person-years in the placebo, metformin, and lifestyle groups, respectively. Intensive lifestyle reduced the incidence of diabetes by 58% compared with placebo (Knowler et al., 2002; Figure 2). This intervention required participants to lose at least 7% of their body weight and participate in at least 150 minutes per week of physical activity. The results of this

study have been somewhat nuanced during long-term follow-up; although both the original lifestyle and metformin interventions significantly reduced diabetes incidence compared with placebo after a median of approximately 21 years, they did not significantly reduce major cardiovascular events when compared with placebo. The reasons for this lack of effect on cardiovascular disease are likely due in part to the fact that all groups received lifestyle treatment, as well as to the widespread use of cardiovascular preventive medication (Goldberg et al., 2022).

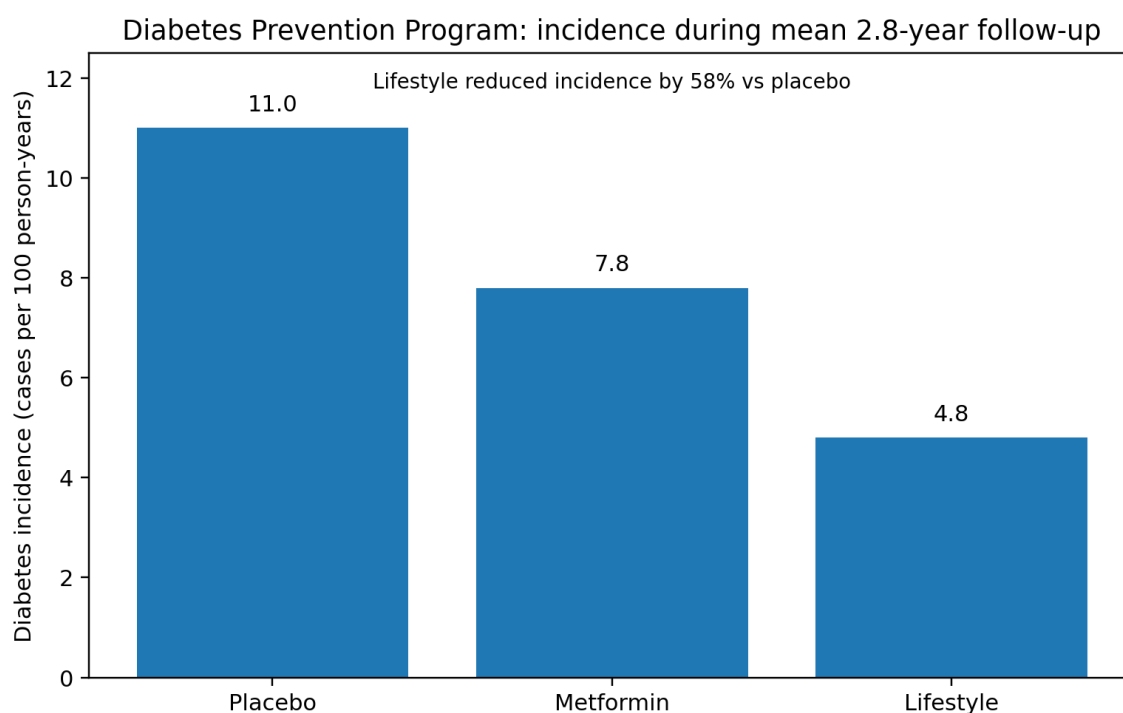


Figure 2. Diabetes incidence in the Diabetes Prevention Program. Data redrawn from Knowler et al. (2002), <https://doi.org/10.1056/NEJMoa012512>.

The existing research supports substantial clinical HbA1c improvement in individuals with type 2 diabetes via participation in a structured exercise program. In this regard, Gallardo-Gómez et al. (2024) found that approximately 1,100 MET-min/week was associated with the greatest modeled HbA1c benefits and also noted that greater reductions in HbA1c were observed when the individual had a higher initial HbA1c value. Additionally, Liang et al. (2024) approximated the average reduction in HbA1c to be -0.78% for HIIT, -

0.54% for combined aerobic and resistance training, -0.45% for yoga, and -0.42% for continuous aerobic training. However, the certainty of these estimates is considered to be relatively low (see Figure 3). As such, the synthesized literature supports reaching the required guideline volume of exercise through an acceptable, safe combination of aerobic and resistance training activities rather than adopting a universal superiority approach for one activity over another.

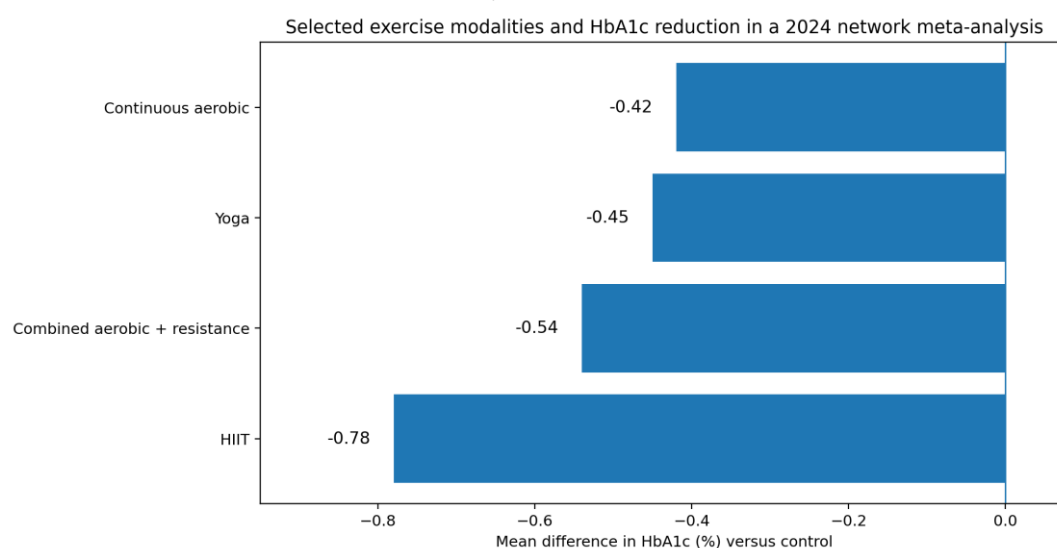


Figure 3. Selected HbA1c effect estimates from Liang et al. (2024). Data redrawn from <https://doi.org/10.1007/s40279-024-02057-6>; the source review rated comparative evidence as low quality.

The clinical importance of the potential adverse effects of physical exercise for the individual is substantial enough to warrant an individually framed approach. For individuals treated with insulin, physical exercise may lead to a decrease in blood glucose levels, potentially leading to hypoglycemia; similarly, high-intensity physical activity during periods of insufficient insulin availability can result in increased blood glucose levels and/or ketone production. Consequently, current

recommendations from the American Diabetes Association (ADA) emphasize that adjustments in insulin and carbohydrate intake, as well as glucose monitoring, should be made on an individual basis, taking into account various factors including proliferative diabetic retinopathy, autonomic neuropathy, peripheral neuropathy, orthostatic hypotension, foot ulcers, and cardiovascular-related symptoms (ADA PPC, 2026). Table 2 outlines some practical considerations.

Table 2. Contemporary exercise prescription and safety considerations

Component	Contemporary recommendation / interpretation	Key safety considerations
Aerobic activity	For most adults with diabetes, ≥ 150 min/week moderate-to-vigorous aerobic activity, spread over ≥ 3 days, with no more than 2 consecutive inactive days.	Start gradually when deconditioned; assess symptoms and complications; individualize for cardiovascular risk and mobility.
Resistance exercise	2-3 sessions/week on nonconsecutive days.	Technique, progressive loading, retinopathy, neuropathy, musculoskeletal limitations, and blood pressure should be considered.
Sedentary time	Break prolonged sitting at least every 30 min with standing, walking, or light activity.	Useful even for people unable initially to meet full exercise targets.
Type 1 / insulin-treated diabetes	Exercise is encouraged but glucose responses vary by intensity and timing.	Monitor glucose; individualize insulin and carbohydrate; prevent exercise-related hypoglycaemia and avoid intense activity during insulin deficiency/ketosis.
Complications	Activity can often continue with modification.	Consider proliferative retinopathy, autonomic or peripheral neuropathy, orthostatic hypotension, foot ulcer/Charcot history, renal disease, and cardiovascular symptoms.

The results from research on yoga have been positive, yet are less conclusive than those for general exercise. In an early clinical trial, Gordon et al. (2008) found similarly large reductions in fasting blood glucose levels with both Hatha yoga and conventional physical training (see Figure 4). However, the 2025 meta-analysis conducted by Vijay et al. found statistically significant decreases in HbA1c and glucose; however, the

substantial heterogeneity among studies, along with numerous concerns regarding risk of bias, limits confidence. Thus, the data suggest that while yoga may be beneficial as a viable adjunctive option for patients who have a preference for this type of intervention, particularly if it promotes greater overall activity or enhances the ability to manage stress, it should not replace standard diabetes management.

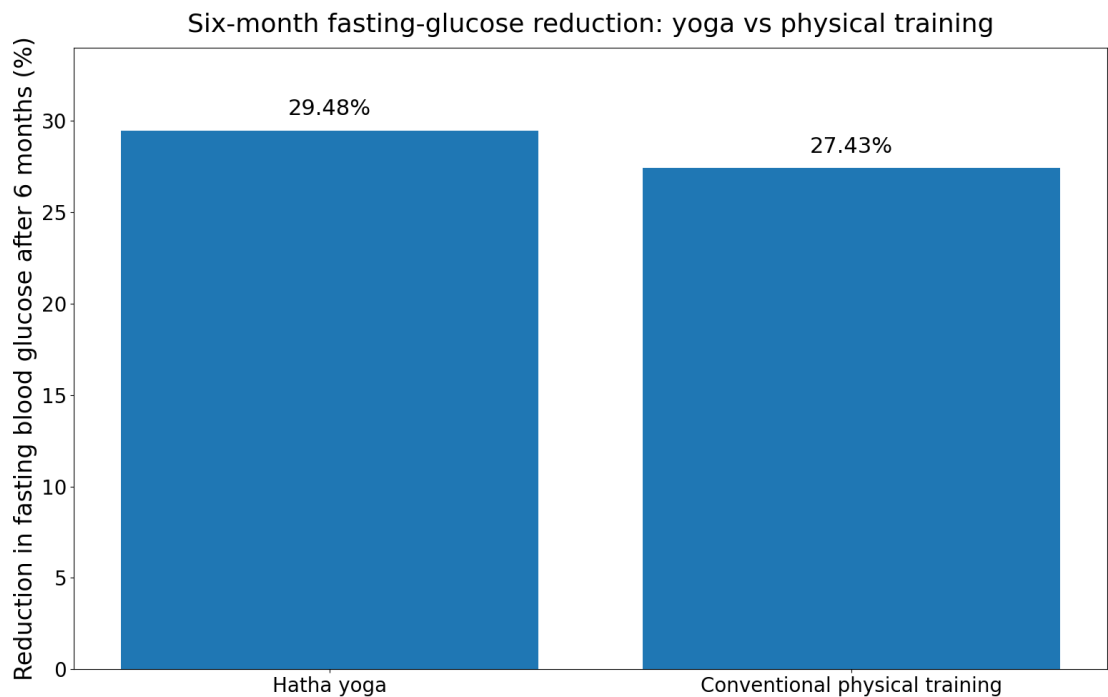


Figure 4. Six-month reduction in fasting blood glucose reported by Gordon et al. (2008). Data redrawn from <https://doi.org/10.1186/1472-6882-8-21>.

Nutrition evidence supports an individually tailored approach to managing diabetes through nutrition rather than recommending one universal macronutrient prescription for all. In a pooled analysis of data from randomized studies on Mediterranean-style diets conducted in 2025, a pooled reduction in HbA1c of about 0.31 percentage points was observed, along with decreases in both fasting plasma glucose and BMI (Wu et al., 2025). While low-carbohydrate diets have been

found to produce small improvements in glycemia in the short term compared with other diets, there is considerable variability across different aspects of low-carbohydrate diets, including the amount of carbohydrates consumed, length of time of the intervention, cultural context, and the type of diet serving as a comparison (Mongkolsucharitkul et al., 2025; Beretta et al., 2025).

Table 3. Selected quantitative evidence informing the updated synthesis

Evidence source	Population / evidence base	Principal quantitative finding	Interpretation
Knowler et al. (2002)	3,234 adults at high risk of type 2 diabetes	Lifestyle reduced diabetes incidence by 58% vs placebo over mean 2.8 years.	Landmark prevention evidence.
Gallardo-Gómez et al. (2024)	126 studies; 6,718 participants with type 2 diabetes	Modeled optimal dose ~1,100 MET-min/week; larger HbA1c reductions with higher baseline HbA1c.	Supports individualized exercise dose.
Liang et al. (2024)	85 RCTs; 5,535 participants	HbA1c MD: HIIT -0.78%; combined -0.54%; yoga -0.45%; continuous aerobic -0.42%.	All may help; comparative evidence rated low quality.

Evidence source	Population / evidence base	Principal quantitative finding	Interpretation
Vijay et al. (2025)	14 RCTs; 1,876 participants	3-month yoga: HbA1c MD -0.55%; FBG -24.72 mg/dL; PPBG -26.01 mg/dL.	Promising but high heterogeneity and risk of bias.
Wu et al. (2025)	11 RCTs of Mediterranean diet	HbA1c MD -0.307%; FPG -0.845 mmol/L; BMI -0.828 kg/m ² .	Supports Mediterranean-style pattern as one evidence-based dietary option.
Topal et al. (2026)	8 trials; 590 participants with diabetic neuropathic pain	Pain MD -1.64 points; quality of life improved.	Supports symptom relief, not glycaemic efficacy.

The medicinal-plant findings were heterogeneous. Cinnamon showed small pooled improvements in some glycaemic outcomes, but product variability, trial quality, and the 2025 expression of concern attached to the influential Khan et al. (2003) paper warrant caution. Fenugreek meta-analysis reported an HbA1c reduction around 0.54 percentage points and improved fasting glucose, but standardization and longer-term safety remain important limitations (Vajdi et al., 2024). Gymnema meta-analysis reported favourable results

with very high between-study heterogeneity (Devangan et al., 2021). Bitter melon illustrates the instability of this evidence base: Zhang et al. (2024) reported significant reductions in fasting glucose and HbA1c, whereas Laczkó-Zöld et al. (2024) found no significant placebo-controlled improvement. No herbal product assessed in this review had evidence sufficiently consistent to justify substitution for standard glucose-lowering therapy.

Table 4. Contemporary appraisal of selected complementary therapies

Product / modality	Proposed rationale / early evidence	Contemporary evidence	Clinical implication
Cinnamon	Early clinical trial reported lower fasting glucose and lipids.	2024 meta-analyses suggest possible benefit, but heterogeneity persists; the influential Khan et al. (2003) article received a 2025 expression of concern.	Do not use as a substitute for standard therapy; interpret older evidence cautiously.
Fenugreek	Traditional use and early studies suggested improved glucose control.	2024 meta-analysis reported lower FPG and HbA1c (~0.54%), with formulation and study-quality variability.	Potential adjunct; standardization and medication interactions require attention.
Gymnema sylvestre	Traditional use and small clinical or preclinical studies suggested glucose-lowering effects.	2021 meta-analysis suggested glycaemic improvement but with very high heterogeneity.	Insufficient certainty for routine recommendation.

Product / modality	Proposed rationale / early evidence	Contemporary evidence	Clinical implication
Momordica charantia (bitter melon)	Traditional use; proposed glucose-lowering action.	Conflicting 2024 meta-analyses: one found HbA1c/FBG reductions; another placebo-controlled synthesis found no significant metabolic effect.	Investigational; evidence is inconsistent.
Aloe vera and several other plants	Evidence has been largely preclinical or limited for several preparations.	Some historical evidence is animal-based and does not establish human clinical efficacy.	Should not be represented as established antidiabetic therapy.
Reflexology	Proposed holistic complementary treatment.	2026 pooled evidence supports neuropathic pain and quality-of-life improvement, not glycaemic control.	Consider only as symptom-oriented adjunct when appropriate.

Reflexology evidence did not support a broad antidiabetic role. The 2026 meta-analysis by Topal et al. found improvement in neuropathic pain and quality of life, which can be clinically relevant for supportive care, but those outcomes are not evidence of improved glycaemic control. The result therefore changes the clinical interpretation rather than eliminating the intervention: reflexology may have a role in symptom management for selected patients when delivered safely, but it should be separated from therapies intended to modify hyperglycaemia.

5. Discussion

The most important finding of this integrative review is that physical activity and individualized nutrition have the strongest and most consistent support, whereas complementary interventions require stratification according to the outcomes actually demonstrated. Modern recommendations advocate for an integrated model of diabetes management. Recommendations focus on the elements of diet, exercise, glucose monitoring, and mental health. For example, the American Diabetes Association (ADA) advocates for all individuals diagnosed with diabetes to have their level of physical activity assessed. It recommends at least 150 minutes per week of moderate-to-vigorous-intensity aerobic activity; resistance training 2–3 times per week;

decreasing sedentary behavior; and developing individualized safety plans (ADA PPC, 2026). Similar to the ADA's position, the American College of Sports Medicine (ACSM) views exercise as a central aspect of treatment, rather than merely recommending it as part of a healthy lifestyle, based upon recent studies (Kanaley et al., 2022).

Exercise in diabetes has been increasingly studied from a mechanistic perspective during the last few years. Muscles consume glucose when they are working, and repeated exercise can result in a reduction in insulin resistance. However, the clinical benefit of this phenomenon is highly dependent upon the volume and type of exercise performed; baseline levels of glycemia; medications used; presence of comorbid conditions; and adherence to prescribed exercise regimens. While Gallardo-Gómez et al. (2024) demonstrated that the amount of HbA1c reduction produced by a given exercise regimen was dose-dependent and could be influenced by the baseline HbA1c concentration, Liang et al. (2024) reported clinically meaningful benefits across multiple modes of exercise. However, due to insufficient comparative data, no single mode of exercise has been identified as being superior to others. Therefore, it would seem reasonable to prescribe exercise based on its feasibility and the preferences of patients, while attempting to meet minimum safe and

effective volumes of exercise.

The comparison of the Diabetes Prevention Program (DPP) further illustrates why interpretation should differentiate between intermediate metabolic outcomes and long-term clinical events. In their 2002 study, Knowler et al. demonstrated that intensive lifestyle intervention significantly reduced the rate at which subjects progressed from high-risk dysglycemia to type 2 diabetes. However, in their 2022 analysis, Goldberg et al. reported no statistically significant difference in rates of major cardiovascular events among subjects randomly assigned to either the original lifestyle group or placebo group over a median period of 21 years. That is not to say that there was no benefit from the Diabetes Prevention Program; it merely indicates that reducing rates of developing diabetes and reducing rates of cardiovascular disease are two separate endpoints, and that factors such as later provision of lifestyle intervention to all groups, background risk-factor management, and medication use can affect the results of comparisons. Therefore, simply demonstrating an improvement in glycemic control (e.g., decreased HbA1c levels) does not provide sufficient evidence of a decrease in cardiovascular mortality.

Yoga serves as an illustrative example of a complementary intervention where the evidence has grown but remains somewhat limited. Initial studies involving yoga were small-scale and indicated potential physiological benefits as well as modest clinical effects. More recent meta-analyses have shown that yoga resulted in improvements in HbA1c levels, fasting glucose levels, and postprandial glucose levels. While these analyses support the use of yoga as part of the total physical activity prescribed to improve metabolic parameters, they also indicate substantial variability within the data (very high heterogeneity), which suggests that the mean effect size obtained from these studies may not reflect what would occur under different conditions (Vijay et al., 2025). As a result, the most prudent interpretation of the available evidence regarding yoga's contribution to improving metabolic status is that yoga can enhance an individual's ability to comply with exercise prescriptions by increasing adherence to a prescribed physical activity regimen, enhancing flexibility and balance, promoting relaxation,

and ultimately contributing to better health outcomes. Thus, based upon this evidence, yoga appears to be of greatest value when it is incorporated into comprehensive care regimens rather than being used as an alternative form of antidiabetic treatment.

Similar recommendations can be made concerning the evaluation of the nutritional evidence supporting diabetes management. As of today, the emphasis for diabetes educators is the use of medical nutrition therapy (MNT), along with encouraging people to eat healthier by making improvements in the overall quality of their diet. Educators focus on helping patients improve their diet quality as opposed to limiting specific amounts of nutrients such as carbohydrates or fat within a patient's diet. Evidence from research has shown that adhering to a Mediterranean-style dietary pattern can lead to better glycemic control and can also be beneficial for reducing cardiovascular risk (Beretta et al., 2025; ADA PPC, 2026; Wu et al., 2025). Some individuals may experience a greater degree of improvement when they consume fewer carbohydrates; however, it should be noted that not all individuals with diabetes may receive the same level of improvement. Instead of recommending restrictive diets based upon specific macronutrients, the purpose of MNT is to help people choose healthy eating patterns that satisfy their individual nutritional requirements, preferences, economic constraints, and support their prescribed medications.

The interpretation of evidence concerning herbal remedies is significantly more complex than interpreting other therapies. Although positive results have been obtained in some initial clinical trials and in animal studies that suggest hypotheses for treatment, these results are rarely useful as guidelines for providing treatment. The example of the cinnamon remedy is particularly illustrative because of an expression of concern published by the American Diabetes Association in 2025 about the influential paper by Khan et al. (2003); however, subsequent meta-analyses continue to show potential for lowering blood glucose levels. However, the credibility of a single early study does not substitute for consistent demonstrations of efficacy using standardized preparations (Bakhach et al., 2024; American Diabetes Association, 2025; Moridpour et al., 2024). Fenugreek and *Gymnema* appear to have

some promise; however, heterogeneity in formulations limits the ability to provide specific dosing recommendations for clinical use. Bitter melon has demonstrated contradictory findings in the current literature, suggesting a need for caution when describing its benefits.

Another form of refinement concerns reflexology. Instead of asking if this type of alternative therapy treats diabetes, the relevant question is what aspects of diabetes-related outcomes might be affected. While pooled evidence did suggest improved outcomes for neuropathic pain and quality of life, there was no support for either HbA1c reduction or slowing the progression of the disease (Topal et al., 2026). A key methodological advance here is that outcome-specific language allows recognition of those supportive treatments that do exist in relation to the disease being treated while avoiding implications of modifying the disease itself.

The novelty of this article lies in the "Evidence-Tier Integration Framework" illustrated in Figure 1. Tier 1 represents the core interventions that have been endorsed by guidelines and have replicated clinical evidence. These include structured physical activity (exercise) and individualized medical nutrition therapy. Tier 2 represents promising adjunct therapies that could reasonably be added to a treatment plan if they are acceptable to the patient. An example of this would be yoga. Tier 3 represents investigational or product-dependent interventions. Medicinal plant-based treatments fall into this tier because there may be some signal for their use; however, there is limited standardization and/or certainty regarding their safety and efficacy as replacements for conventional drugs. Tier 4 represents symptom-oriented supportive practices. Reflexology falls under this category since its value should be determined through evaluation of the outcomes assessed in studies conducted to evaluate it. This tiered system allows non-pharmacological treatment options to be evaluated separately from one another based upon the level of supporting evidence and associates each option with those outcomes supported by existing research.

There are several important limitations to consider. This is an integrative review rather than a new systematic review or meta-analysis. While the literature reviewed

was extensive, a complete search of all databases was not performed, nor was the risk of bias associated with each study included in the analysis assessed. The review encompasses both recently published reviews and older studies. Additionally, many of the earlier reports of complementary/alternative therapies were based on small sample sizes, varied protocols, and often relied on animal models or laboratory experiments. There is also significant variability in the strength of evidence available for each intervention, with strong data available for exercise and nutritional interventions, while much weaker evidence exists for the use of medicinal plants and reflexology. Finally, the majority of the quantitative data for exercise and yoga have been derived from patients with type 2 diabetes. Direct application of these findings to individuals with type 1 diabetes should be approached cautiously due to potential differences in pharmacotherapy regimens and glucose management strategies.

6. Conclusion

Physical activity is the most consistently supported non-pharmacological intervention examined in this review. Contemporary evidence confirms that regular aerobic activity, resistance training, and reduced sedentary time improve glycaemic and cardiometabolic outcomes and should be integrated with medication, monitoring, and complication screening. Nutrition should likewise be individualized and evidence-based rather than defined by a single restrictive macronutrient rule. Yoga can be a useful adjunct, particularly when it improves adherence and total activity, but heterogeneity limits claims of equivalence to standard exercise programmes. Herbal products should be considered individually and cautiously; promising pooled effects do not overcome problems of trial quality, preparation variability, conflicting findings, or the absence of long-term outcome evidence. Reflexology may have a supportive role for diabetic neuropathic pain but should not be characterized as a glucose-lowering treatment. The paper's principal academic contribution is an outcome-specific evidence hierarchy that separates core therapy, promising adjuncts, investigational products, and symptom-oriented supportive care. This model offers a more rigorous basis for integrating conventional and complementary approaches while preserving patient choice and clinical safety.

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