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Traditional Chinese Medicine as a Non-Prescription Approach to Diabetes Self-Management

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Abstract

Type 2 diabetes mellitus (T2DM) is a prevalent chronic condition requiring lifelong self-management. We conducted a comprehensive literature review examining systematic reviews, meta-analyses, and clinical trials that evaluated Traditional Chinese Medicine (TCM) modalities—including Chinese herbal remedies, acupuncture, and mind-body exercises (Tai Chi, Qigong)—as adjuncts in T2DM care. Our analysis revealed that Chinese herbal therapies showed mixed but often positive effects on glycemic control. Notably, berberine (huanglian) lowered HbA1c and fasting glucose comparably to metformin, and Astragalus-based formulas modestly improved insulin resistance. In contrast, other herbs (bitter melon, ginseng) yielded weak or inconsistent benefits. When acupuncture was added to usual care, it produced modest but significant reductions in HbA1c and fasting glucose in pooled analyses and notably relieved diabetic neuropathic pain. Mind-body exercises (Tai Chi, Qigong) led to mild improvements in glycemic markers, with small HbA1c declines and consistently enhanced quality of life and psychological well-being. Most importantly, combining TCM modalities often provided additive effects: integrative programs (herbal + acupuncture + exercise) demonstrated superior glycemic outcomes and metabolic profiles compared to single therapies or lifestyle advice alone. However, the evidence base is limited by small, short-term trials with methodological and publication biases, so results should be interpreted cautiously. Nevertheless, this review highlights the potential of evidence-based TCM approaches as holistic, patient-centered complements to standard diabetes care. Further large-scale, rigorous trials are needed to confirm these benefits and guide safe integration of TCM into diabetes self-management.

Keywords

Type 2 Diabetes Mellitus, Traditional Chinese Medicine, Integrative Medicine, Diabetes Self-Management, Herbal Medicine, Acupuncture, Mind-Body Exercises

1. Introduction

Type 2 diabetes mellitus (T2DM) represents one of the most pressing global public health challenges of our time. Over recent decades, the prevalence of diabetes has increased dramatically, rising from an estimated 200 million people in 1990 to over 830 million in 2022. Currently, according to the World Health Organization, approximately 14% of adults worldwide live with diabetes, with the vast majority (≈95%) having type 2 diabetes [1]. This epidemic has accelerated particularly rapidly in low- and middle-income countries, driven by urbanization, aging populations, obesity, and sedentary lifestyles.

The burden extends far beyond prevalence figures. Diabetes imposes enormous human and economic costs globally. Each year, diabetes and its complications account for approximately 3.4 million deaths (one every 9 seconds) and at least USD 1 trillion in annual health expenditures—representing more than a 300% increase over the past two decades [2]. In the United States alone, the total economic cost of diagnosed diabetes in 2022 reached $412.9 billion, with $306.6 billion attributed to direct medical costs [3]. These figures underscore that diabetes not only causes debilitating complications—including cardiovascular disease, renal failure, blindness, and amputations—but also places an unprecedented strain on health systems and economies worldwide.

Managing type 2 diabetes effectively requires sustained, lifelong intervention. As a chronic metabolic disorder, diabetes cannot be cured, and high-quality care depends fundamentally on active patient engagement. Importantly, patient self-management serves as an integral component of chronic disease care models [4]. Given that patients spend only a few hours per year with clinicians, they must independently manage diet, physical activity, blood glucose monitoring, and medication for the vast majority of their time. The World Health Organization emphasizes that supporting patients in self-managing their conditions is crucial for improving outcomes and preventing complications [5]. Evidence demonstrates that well-designed self-management programs—involving education, goal-setting, and behavioral support—improve glycemic control, quality of life, and treatment adherence in diabetes care.

Lifestyle interventions remain the cornerstone of diabetes management. The WHO notes that "one of the most important ways to treat diabetes is to keep a healthy lifestyle", emphasizing that diet, exercise, and weight management can delay or even prevent type 2 diabetes onset [1]. However, standard pharmacotherapy alone has significant limitations. Many patients taking multiple glucose-low-

ering medications still fail to achieve glycemic targets, while drug regimens often involve side effects, substantial costs, and adherence challenges. For instance, diabetes patients in the U.S. incur 2.6 times higher medical expenditures than non-diabetics, with considerable costs attributed to glucose-lowering medications and supplies [3]. Moreover, glycemic control frequently remains suboptimal even with advanced medications, and comorbid conditions such as hypertension and dyslipidemia require additional pharmacological interventions. These limitations have sparked growing interest in complementary strategies that address lifestyle factors and whole-person wellness alongside conventional medical care.

Traditional Chinese Medicine emerges as a promising complementary approach. TCM represents an ancient, holistic medical system used for millennia throughout East Asia. Grounded in theories of balance and harmony—such as Yin-Yang and Qi circulation—TCM conceptualizes health as an integrated state encompassing mind and body. Classical TCM texts describe "Xiaoke" or "consumptive thirst" conditions, which parallel modern diabetes, and prescribe diet, exercise, and herbal therapies to restore physiological balance. Contemporary TCM practice encompasses diverse non-pharmacological and over-the-counter approaches, including Chinese herbal formulas, acupuncture, moxibustion, therapeutic massage (Tui Na), cupping, and mind-body exercises such as Tai Chi and Qigong [6]. Rather than focusing solely on blood glucose levels, these modalities aim to support holistic wellness by enhancing vitality, reducing stress, and improving circulation.

Current utilization patterns reflect growing acceptance of TCM approaches. Recent surveys indicate widespread adoption of TCM among individuals with diabetes in China and the Asia-Pacific region, often in conjunction with Western medicine. Notably, one international TCM guideline identifies TCM as "one of the earliest complementary and alternative medicines worldwide to explore the prevention and treatment of diabetes", citing numerous clinical studies from the past decade that report beneficial effects of TCM therapies on glycemic control and diabetic symptoms [7]. While study quality and design vary considerably, the longstanding history and continued utilization of TCM in chronic disease management suggest potential value for patients seeking non-prescription therapeutic options.

This interest aligns with broader healthcare trends toward integrative approaches. Major health agencies increasingly advocate combining conventional medicine with evidence-based complementary therapies to achieve comprehensive, patient-centered care. For example, the U.S. National Institutes of Health's National Center for Complementary and Integrative Health (NCCIH) explicitly recognizes TCM practices—including acupuncture, Tai Chi, and herbal therapy—as interventions that can enhance quality of life and symptom management [6]. Similarly, the World Health Organization has launched an ambitious Traditional Medicine Strategy (2025-2034) promoting evidence-based integration of traditional and complementary medicine into national health systems. Recent WHO resolutions have urged

member states to support safe, effective, and culturally appropriate traditional medicine applications for chronic diseases [8].

In the U.S. and Europe, healthcare delivery is evolving to incorporate these principles. Clinics and research programs increasingly explore integrative health models where multidisciplinary teams provide lifestyle counseling, mind-body exercises, and select alternative therapies in coordination with standard care. This trend responds both to patient demand for natural, holistic treatments and to emerging evidence that certain complementary approaches—including yoga, stress reduction techniques, and specific supplements—can support diabetes prevention and symptom management.

The convergence of epidemiological urgency and patient-centered care has renewed scientific interest in TCM for diabetes management. A substantial literature now addresses TCM modalities for diabetes, including systematic reviews and meta-analyses examining herbal medicines, acupuncture, dietary therapies, and movement practices. The present review synthesizes this evidence to clarify TCM's role in diabetes self-management. In subsequent sections, we examine traditional Chinese health concepts relevant to diabetes, survey clinical research on specific TCM interventions (herbs, acupuncture, and mind-body exercises) for glycemic control and well-being, and discuss how these approaches might complement standard medical care. Our objective is to provide an evidence-based assessment of TCM as a non-prescription strategy for patients and providers pursuing integrated diabetes management approaches.

2. Methods

2.1. Review Approach and Reporting

We conducted an integrative evidence review focused on clinical research evaluating TCM modalities for adults with T2DM. Reporting aligns with key elements of PRISMA 2020 where applicable to integrative syntheses. No protocol was prospectively registered.

2.2. Information Sources and Search Strategy

Electronic searches were performed in PubMed/MEDLINE and the Cochrane Library from January 1, 2006 to July 31, 2025. Search strings combined controlled vocabulary and free-text terms for TCM modalities and diabetes using Boolean operators, e.g., ("Traditional Chinese Medicine" OR herbal OR acupuncture OR "Tai Chi" OR qigong OR "mind-body") AND ("type 2 diabetes" OR T2DM) AND (random OR trial OR "systematic review" OR "meta-analysis"). To reduce retrieval bias, we also conducted backward/forward citation chasing of key articles and consulted authoritative sources (e.g., WHO and NIH/NCCIH pages and guidance documents) for context. We did not search clinical trial registers; when influential registered trials were cited in included reviews, we traced primary publications where possible. No geographic restrictions were applied; English-language full texts were analyzed.

2.3. Eligibility Criteria (PICOS)

- Population (P): Adults (≥18 years) with T2DM; studies in prediabetes were included when outcomes were directly relevant to glycemic management.
- Interventions (I): TCM modalities feasible as non-prescription adjuncts—Chinese herbal medicines/formulas, acupuncture (including electroacupuncture), and mind-body exercises (Tai Chi, Qigong).
- Comparators (C): Placebo/sham, usual care/lifestyle advice, or active pharmacological comparators.
- Outcomes (O): At least one glycemic/metabolic endpoint (HbA1c, fasting or 2-h postprandial glucose, HOMA-IR/insulin sensitivity) and/or patient-centered outcomes (e.g., neuropathic symptoms, quality of life); safety/adverse events were extracted whenever they were reported.
- Study designs (S): Randomized controlled trials (RCTs), systematic reviews, and meta-analyses.
- Exclusions: Non-randomized or single-arm clinical studies; animal/*in vitro* studies; pediatric or type 1 diabetes populations; studies in which the TCM component could not be isolated; conference abstracts without peer review; articles lacking extractable outcomes or full text.

2.4. Study Selection

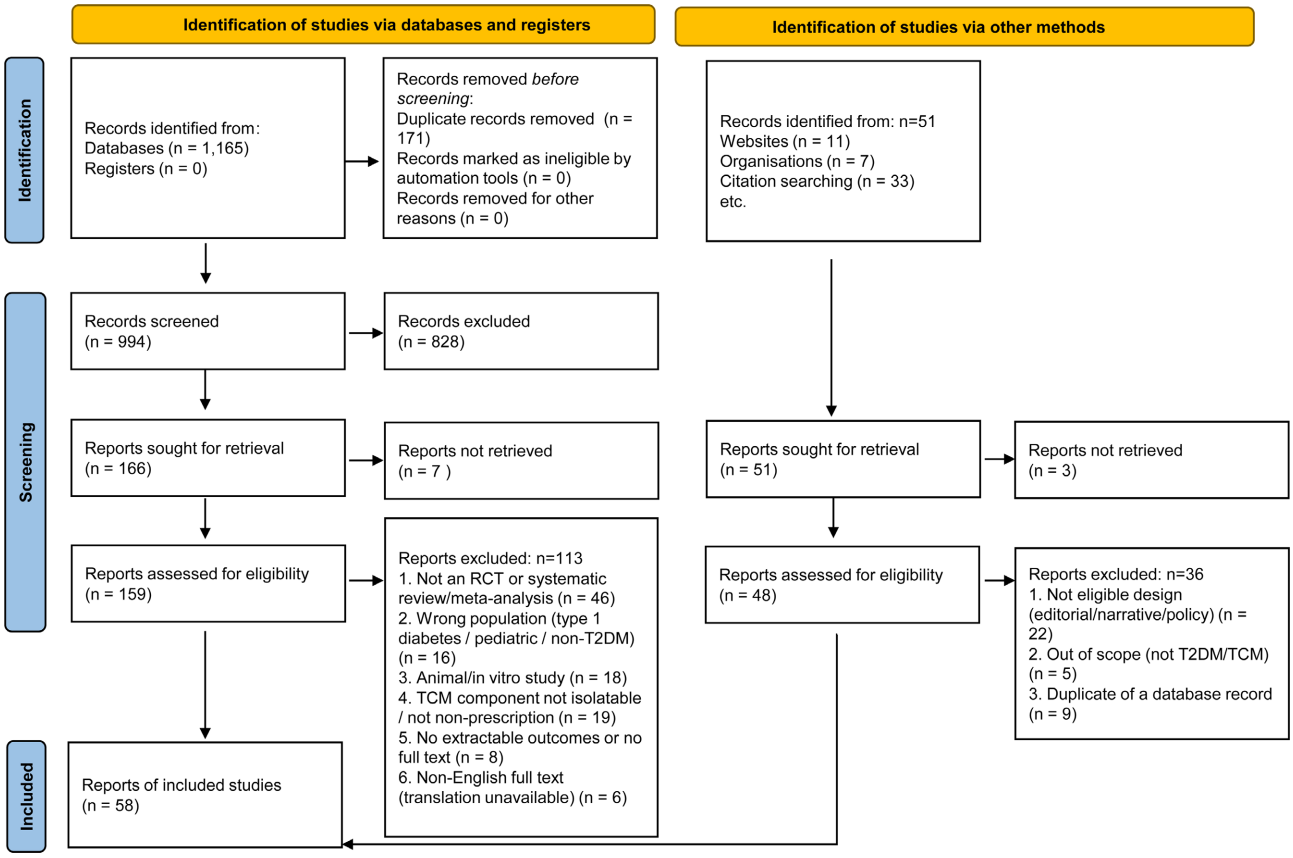
All search results were de-duplicated (reference manager) and first screened by a single reviewer (primary author) by title/abstract for relevance to T2DM and the prespecified modalities/outcomes. Full texts of potentially eligible articles were then assessed against the eligibility criteria. To enhance reliability in a single-reviewer workflow, a senior author independently verified borderline decisions and a random sample (~20%) of inclusions/exclusions; differences were resolved by discussion. We followed PRISMA 2020 guidance; a flow diagram of identification, screening, eligibility, and inclusion is provided in **Figure 1**.

2.5. Data Extraction and Outcomes

For each included article, we extracted study design and setting, participant characteristics, intervention details (herb identity/formula and dose; acupuncture protocol and frequency; exercise type and dose), comparators, follow-up, and prespecified outcomes (HbA1c, fasting/postprandial glucose, HOMA-IR/insulin sensitivity, symptom or quality-of-life measures). Adverse events (frequency, severity, withdrawals) were extracted verbatim where available. Data extraction was performed by the primary author using a standardized spreadsheet.

2.6. Risk-of-Bias Assessment

We assessed RCTs using Cochrane RoB 2 across standard domains (randomization, deviations from intended interventions, missing outcome data, outcome measurement, selective reporting). Systematic reviews/meta-analyses were appraised with AMSTAR 2. Overall, included trials exhibited moderate risk of bias—most



Flowchart illustrating the selection process for studies on Traditional Chinese Medicine interventions for type 2 diabetes mellitus (T2DM). Sources included PubMed/MEDLINE, Cochrane Library, WHO/NCCIH webpages, and forward/backward citation tracking. Only full-text articles published in English were considered.

Figure 1. PRISMA 2020 flow diagram for study selection of TCM interventions in type 2 diabetes (2006-2025).

commonly limited blinding, small samples, and short follow-up—while most reviews were rated low to moderate on AMSTAR 2 owing to lack of protocol registration and incomplete publication-bias assessment.

2.7. Synthesis

Given heterogeneity in populations, comparators, and outcome definitions, we undertook a narrative synthesis organized by modality (herbal, acupuncture, mind-body) and key outcomes (glycemic indices, insulin sensitivity, symptoms/quality of life), giving greater weight to recent high-quality meta-analyses and well-conducted RCTs. We did not perform a de novo meta-analysis.

3. Results

Traditional Chinese Medicine encompasses a comprehensive array of non-pharmacological strategies that may support glycemic control through diverse physiological mechanisms. Unlike conventional pharmacologic interventions that target specific molecular pathways, TCM modalities typically exert multitargeted, synergistic effects involving metabolic regulation, inflammation suppression, neuroen-

docrine balance, and stress modulation. To elucidate their potential role in diabetes self-management, this section organizes TCM interventions according to primary mechanistic pathways and evaluates the corresponding clinical evidence.

Our analysis focuses on three core domains: herbal medicine, acupuncture, and mind-body therapies—each supported by increasing scientific interest and patient adoption. While these modalities are often studied individually, they are frequently combined in clinical practice, prompting our examination of integrated approaches in real-world contexts. This framework aims to bridge traditional concepts with modern evidence by assessing how distinct TCM strategies contribute to improved glucose metabolism, insulin sensitivity, and holistic well-being in patients with type 2 diabetes.

3.1. Chinese Herbal Medicine

Chinese herbal remedies have been employed for centuries to manage hyperglycemia. Key botanical agents include *Coptis* (huanglian, the source of berberine), *Astragalus* (huangqi), *Momordica charantia* (bitter melon), and *Panax ginseng*. These herbs contain bioactive compounds that influence multiple metabolic pathways. For example, berberine, an isoquinoline alkaloid, activates AMP-activated protein kinase (AMPK), reduces hepatic gluconeogenesis and lipogenesis, and exerts anti-inflammatory effects. Similarly, Astragalus polysaccharides and flavonoids enhance insulin sensitivity through PPAR-γ and PI3K/AKT signaling while providing antioxidant and anti-inflammatory actions [9]. Additionally, bitter melon's charantin and polypeptide P demonstrate insulin-mimetic and antioxidant properties [10], while ginsenosides from *P. ginseng* stimulate AMPK and insulin signaling. Although animal studies support these biochemical mechanisms, clinical evidence shows considerable variation.

Among herbal interventions, berberine demonstrates the strongest clinical support. In a randomized trial (N = 36) comparing berberine with metformin, berberine monotherapy significantly reduced HbA1c (from ≈9.5% to 7.5%) and fasting glucose (10.6 → 6.9 mmol/L) over three months. A subsequent study (N = 48) found that adding berberine to standard therapy further decreased HbA1c (8.1% → 7.3%, $P < 0.001$), fasting glucose, and HOMA-IR (by ~45%), with concurrent improvements in lipid profiles and body weight. These findings suggest that berberine's efficacy parallels that of metformin for glycemic control while providing additional benefits for dyslipidemia [11].

Astragalus demonstrates more modest but consistent benefits. A recent meta-analysis of 20 trials, predominantly involving Chinese patients, found that adjunctive Astragalus (administered as raw herb or extract) plus standard therapy significantly reduced fasting glucose, postprandial glucose, HbA1c, and HOMA-IR compared to usual care. Subgroup analyses revealed that Astragalus-based formulations improved HOMA-IR and lipid profiles. However, the authors rated the evidence quality as "low" due to study bias. Supporting these clinical findings, preclinical research confirms that astragalus polysaccharides upregulate PPAR-γ and the

PI3K/AKT-GLUT4 pathway, thereby promoting glucose uptake in adipocytes [9].

In contrast, evidence for bitter melon remains weak. A Cochrane review (4 RCTs, N = 479) identified no significant differences between *Momordica charantia* products and placebo or conventional drugs (metformin/glibenclamide) regarding glycemic outcomes. Reported adverse events were minor, primarily involving gastrointestinal discomfort. Consequently, current data do not support routine bitter melon use for T2DM management, pending more rigorous trials [10]. A recent PRISMA-compliant meta-analysis of 9 randomized trials (total N = 414, follow-up 4 - 16 weeks) found no significant advantages of *Momordica charantia* (bitter melon) over placebo or standard care for glycemic control. Specifically, the pooled mean difference in fasting plasma glucose was only −0.03 mmol/L (95% confidence interval: −0.38 to +0.31), and for HbA1c it was −0.12% (95% CI: −0.35 to +0.11)—neither being statistically significant. Bitter melon also showed no clear effects on body weight or lipid profiles in these trials. Notably, the same 2024 meta-analysis reported that liver and renal function markers (ALT, AST, creatinine) did not differ between the bitter melon and control groups [12], underscoring its short-term tolerability. Therefore, current evidence does not support routine use of bitter melon for glycemic control in T2DM—at least not in the dosages and durations studied—and any potential benefits remain uncertain. Larger, longer-term trials of higher methodological quality are needed to determine if bitter melon (or ginseng and other herbal supplements) can confer clinically meaningful glycemic improvements beyond standard care.

Ginseng extracts show limited efficacy. A meta-analysis of 16 RCTs demonstrated that Panax species (*Panax ginseng* or ginseng berry) slightly reduced fasting blood glucose (mean difference ≈ −0.31 mmol/L, P = 0.03) in individuals with or without diabetes. No clear HbA1c benefit emerged overall, though a subgroup of crossover trials suggested modest HbA1c reduction. While mechanistic studies indicate that ginsenosides enhance insulin secretion and stimulate AMPK, large-scale standardized trials are needed [13]. More recent syntheses refine this picture: a 2022 PRISMA-guided meta-analysis restricted to prediabetes/T2DM (20 RCTs) found significant improvements in fasting plasma glucose and HOMA-IR but no overall effect on HbA1c, with substantial between-study heterogeneity and low-to-moderate certainty of evidence [14]. An umbrella review in 2023 concluded that ginseng may benefit selected metabolic indicators but rated the underlying meta-analyses mostly low or critically low on AMSTAR-2/GRADE and emphasized the need for higher-quality RCTs [15]. In line with these findings, a 2024 double-blind RCT in prediabetes reported improvements on OGTT-related glycemic measures but no consistent HbA1c change over 12 weeks, supporting short-term physiological effects yet underscoring the gap in long-duration, standardized trials in T2DM [16].

Several investigations have examined herbs as adjuncts to conventional medications. For example, adding berberine to metformin/statin regimens improved glycemic and lipid parameters and insulin resistance beyond drug therapy alone

[11]. Similarly, combination botanical formulas, such as Astragalus-based "Tianqi" capsules, have demonstrated glucose-lowering synergy. In one randomized trial involving 420 prediabetic adults (mean age ~53), "Tianqi" capsules plus lifestyle modification reduced T2DM progression by 32% compared to placebo over one year [17]. These results suggest that certain TCM formulas may be particularly beneficial for older adults or high-risk populations.

3.2. Acupuncture

Acupuncture—the stimulation of specific body points through needle insertion—exerts complex neuroendocrine effects that may enhance glucose metabolism. Preclinical studies demonstrate that needling specific acupoints modulates the hypothalamic-pituitary-adrenal (HPA) axis and autonomic nervous system balance. For instance, electroacupuncture at the Yishu (EX-B3) point reduced adrenal cortisol levels and attenuated HPA-axis hyperactivity in diabetic rats [18]. Additionally, acupuncture can rebalance sympathetic and parasympathetic tone through mechanisms involving opioid/GABAergic pathways in the brainstem that inhibit excessive sympathetic outflow [19]. These autonomic and endocrine adjustments may optimize insulin action.

Acupuncture consistently enhances insulin-signaling pathways. Specifically, needling at Zusanli (ST36) and related points increases muscle GLUT4 and IRS-1/2 expression while reducing inhibitory PI3K-p85 levels, thereby activating PI3K/Akt signaling [18]. A recent meta-analysis of animal T2DM models confirmed that acupuncture increases IRS-1, PI3K, and Akt phosphorylation and elevates GLUT4/GLUT4-mRNA expression while suppressing insulin resistance [20]. These molecular changes translate into improved insulin sensitivity (reduced HOMA-IR) and lower fasting insulin levels in clinical trials [21]. Furthermore, acupuncture appears to reduce inflammation and oxidative stress, with studies reporting significant decreases in serum CRP and malondialdehyde (MDA) following acupuncture treatment in diabetic patients [18]. Such anti-inflammatory effects could protect β-cells and vascular structures. In addition, broader reviews suggest that acupuncture may influence immune regulation through combined mechanisms, further linking its systemic effects to metabolic and stress-related pathways [21]. Collectively, this evidence suggests that acupuncture may enhance glucose uptake through insulin signaling and nitric oxide pathways while normalizing metabolic hormone balance via neuroendocrine modulation.

Clinical trials have begun testing these mechanistic hypotheses through glycemic outcome assessments. Several systematic reviews and meta-analyses of randomized controlled trials have identified modest but significant improvements in blood glucose control when acupuncture is added to usual care. A 2025 meta-analysis (21 RCTs, n ≈ 2100) reported that adjunctive acupuncture produced greater reductions in HbA1c, fasting glucose, and 2-hour postprandial glucose compared to controls [20]. A separate 2025 meta-review similarly found that acupuncture significantly lowered mean HbA1c (standardized mean difference [SMD] ≈ −0.54,

95% CI: −1.03 to −0.06) and fasting plasma glucose (SMD ≈ −0.35) versus control treatments. Improvements in insulin resistance indices (HOMA-IR) and fasting insulin were also documented (HOMA-IR SMD ≈ −0.51, fasting insulin SMD ≈ −1.09) [22]. However, effect sizes vary considerably across trials, and pooled heterogeneity remains high. Many studies originate from China and exhibit methodological limitations, including small sample sizes and unclear blinding procedures [20].

Acupuncture shows particular promise for diabetic neuropathy management. In patients with painful diabetic peripheral neuropathy, meta-analyses indicate substantial pain relief and nerve conduction improvements. One comprehensive review (36 trials, n ≈ 2740 patients with painful diabetic neuropathy) found strong pooled reductions in pain severity (VAS; SMD ≈ −1.27, 95% CI: −1.58 to −0.95) with acupuncture versus standard care. Corresponding increases in nerve conduction velocity (e.g., median nerve ↑3.6 m/s) were also observed. Importantly, these improvements in pain and neurological function occurred without increased adverse events. The pooled adverse-event rate did not differ from controls [20], and acupuncture is generally considered safe and noninvasive. Nevertheless, Cochrane reviewers note that evidence quality remains very low, necessitating larger, well-blinded trials [22].

In summary, high-quality evidence from RCTs and meta-analyses suggests that acupuncture may adjunctively improve glycemic indices (HbA1c, fasting blood glucose) and alleviate diabetic neuropathic symptoms [20] [23]. However, the evidence base contains notable limitations: many trials are small and heterogeneous, often lacking rigorous blinding or appropriate sham controls, which elevates the risk of bias [20] [22]. Publication bias represents another concern, as funnel plots demonstrate asymmetry for some outcomes [20] [23]. Given these methodological issues, major guidelines, including Cochrane reviews, conclude that current evidence insufficiently supports acupuncture as a primary diabetes treatment [22]. While acupuncture demonstrates promising biological plausibility and some clinical effects on glucose regulation and neuropathy, its efficacy in T2DM self-management requires further confirmation through rigorous clinical trials.

3.3. Mind-Body Exercises (Therapies)

Mind-body therapies (MBTs), including Tai Chi, Qigong, and yoga, have garnered increasing attention as non-pharmacological strategies for supporting glycemic control and psychological well-being in patients with type 2 diabetes. These practices integrate gentle physical activity with focused breathing and mental concentration, potentially improving glucose metabolism through multiple pathways. Proposed mechanisms include enhanced insulin sensitivity through muscular activity, modulation of stress-related neurohormonal axes (HPA and autonomic nervous systems), and improved mood, sleep quality, and treatment adherence through mindfulness and psychological regulation [24]. Neuroimaging studies suggest that MBTs can reduce amygdala hyperactivity and promote parasympathetic dom-

inance, leading to decreased cortisol levels and reduced systemic inflammation—creating a favorable metabolic environment for T2DM patients [25]. Recent reviews further highlight that Tai Chi may modulate immune mechanisms, suggesting additional systemic pathways through which mind-body practices influence metabolic and psychological health [26].

Clinical evidence increasingly supports MBTs' role in diabetes management. A 2018 Cochrane review (20 RCTs, n > 1300) found that Tai Chi significantly improved fasting blood glucose (mean difference: −0.72 mmol/L), HbA1c (−0.36%), and HOMA-IR in patients with T2DM compared to control interventions [27]. Complementing these findings, a 2023 NIH-funded meta-analysis concluded that mind-body interventions, including Qigong and yoga, produced small but statistically significant reductions in HbA1c (pooled effect size: −0.39%) and fasting glucose (mean reduction: 0.51 mmol/L) over 12 weeks [28]. While these improvements are modest, they are comparable to effects observed with first-line oral medications in certain populations, particularly when MBT adherence is maintained long-term.

Beyond glycemic benefits, MBTs demonstrate consistent benefits for mental health and quality of life in diabetic populations. Studies report improvements in depression scores (e.g., PHQ-9 reduction ≥ 3 points), anxiety levels, and diabetes-related distress, which can directly influence self-care behaviors and metabolic outcomes [29]. A recent WHO-endorsed guideline emphasizes the importance of psychological interventions in chronic disease management, citing MBTs as viable options for enhancing self-efficacy, motivation, and stress coping among diabetes patients [30]. Given the bidirectional relationship between stress and glycemic variability, these psychological benefits may be clinically meaningful. Emerging evidence also links meditation practices to modulation of the neuro-immuno-endocrine axis, providing biological plausibility for their effects on stress reduction and long-term metabolic regulation [31].

Tai Chi and Qigong are particularly well-suited for elderly or mobility-limited patients. In one multicenter RCT involving older adults with T2DM (mean age 67), six months of group-based Tai Chi reduced HbA1c by 0.5% and improved balance and sleep quality compared to stretching exercises [32]. Notably, no serious adverse events were reported. MBTs are generally considered safe, cost-effective, and scalable, making them attractive for population-level implementation, especially in resource-limited settings.

In summary, mind-body therapies offer a biologically plausible, evidence-supported, and patient-centered approach to complement standard T2DM care. Their favorable safety profile and additional psychological benefits justify their inclusion in integrative diabetes management programs.

3.4. Integrated Approaches

3.4.1. Biological Rationale for Multimodal Synergy

Given the multifactorial pathogenesis of T2DM, concurrently targeting multiple

physiological pathways may yield synergistic benefits. Each TCM modality offers distinct but complementary mechanisms of action. For example, herbal medicines provide bioactive compounds that improve insulin sensitivity by reducing inflammation and regulating glucose and lipid metabolism [33]; acupuncture can modulate neuroendocrine and immune function, enhancing insulin signaling while lowering stress hormones and pro-inflammatory cytokines [34]; and mind-body exercises (e.g., Tai Chi or Qigong) reduce psychosocial stress and improve muscle glucose uptake through gentle physical activity. By integrating these approaches, a holistic TCM regimen can address the metabolic, neuroendocrine, and psychosocial dimensions of T2DM more comprehensively than any single therapy alone.

TCM has long emphasized such holistic, integrative treatment philosophies, often combining herbal, acupuncture, and exercise therapies to simultaneously target multiple facets of disease [33]. For example, a patient may receive an individualized herbal formula, weekly acupuncture sessions, and daily Qigong/Tai Chi practice. Such multimodal regimens are designed to harness complementary mechanisms: herbs modulating insulin sensitivity and inflammation, acupuncture altering neurohormonal feedback and autonomic regulation, and Tai Chi improving insulin action through mild exercise and stress reduction. While rigorous trials of fully integrated TCM programs remain scarce, many clinical reports describe additive therapeutic benefits when these modalities are used together.

Preliminary evidence supports the synergistic potential of combined TCM interventions. In one randomized trial of overweight T2DM patients, adding acupuncture to standard diet-and-exercise counseling (without changing medications) led to significantly greater reductions in visceral and hepatic fat compared to lifestyle intervention alone [35]. This suggests that TCM adjuncts can amplify the core metabolic improvements from lifestyle changes. Similarly, a Chinese systematic review noted that multi-component TCM "non-drug" interventions—including dietary therapy, exercise/Qigong, acupuncture, and emotional regulation—significantly improved glycemic control and delayed progression from prediabetes to diabetes [33]. The following subsections examine key clinical evidence for these integrative strategies in T2DM.

3.4.2. Combined Herbal Medicine and Acupuncture

In China's integrative medical settings, Chinese herbal decoctions (selected according to TCM syndrome patterns) are frequently paired with acupuncture treatments. Although few high-quality trials have isolated this specific combination, available evidence appears promising. For instance, a meta-analysis found that adding acupuncture to standard care (including hypoglycemic medications) produced greater HbA1c and insulin improvements than medications alone [36]. Theoretically, acupuncture may enhance herbal efficacy by improving qi/blood circulation and drug absorption, while herbs provide bioactive compounds targeting insulin resistance pathways.

One trial comparing electroacupuncture plus metformin versus metformin with sham acupuncture demonstrated significant reductions in fasting insulin and

HOMA-IR [36]. Similarly, small studies examining combined herbal formulas plus acupuncture report superior fasting blood glucose control and symptom relief compared to either intervention alone, though many remain unpublished or non-randomized. These integrative treatments align with WHO-endorsed strategies that combine conventional medications with traditional therapies for chronic disease management.

As an illustration of real-world practice, a comprehensive TCM program might provide a "Liuwei Dihuang"-type formula for yin deficiency, weekly needling at back-shu and leg acupoints, and dietary counseling—with clinicians observing incremental HbA1c improvements when both interventions are implemented together. The evidence base for herbal acupuncture combinations continues to emerge; ongoing trials will help define the magnitude of therapeutic synergy.

3.4.3. Combined Acupuncture and Mind-Body Exercises

Acupuncture and TCM mind-body exercises address different aspects of metabolic health, and their combination may produce particularly synergistic effects. A recent Shanghai trial randomized obese T2DM patients to lifestyle modification with or without acupuncture. After 12 weeks, the acupuncture group (receiving 12 weekly sessions) demonstrated significantly greater reductions in central and hepatic fat by MRI compared to the lifestyle intervention alone, despite similar weight loss between groups. Additionally, continuous glucose monitoring revealed lower glucose excursions in the acupuncture group [36].

From a practical perspective, patients practicing daily Tai Chi to improve muscle glucose uptake and stress management might derive additional benefits from regular acupuncture (targeting points such as ST36, SP6) to enhance insulin signaling pathways. Meta-analyses of Tai Chi as a standalone intervention consistently demonstrate modest but significant glycemic benefits. For example, a pooled analysis of approximately 800 T2DM patients found that Tai Chi, compared to usual care, reduced HbA1c by about 0.88% on average and lowered insulin resistance (HOMA-IR) by ~0.41 units. Research suggests that long-term Tai Chi practice provides superior HbA1c reduction compared to general aerobic exercise [37].

Acupuncture similarly improves glucose control as a standalone intervention. In one pilot RCT, adding acupuncture to standard care lowered mean 24-hour glucose levels from ~165 to 143 mg/dL ($p < 0.02$) [36], whereas no comparable reduction occurred without acupuncture. Together, these data suggest that combining acupuncture (which may act on peripheral nerves and hormonal systems) with Tai Chi (which enhances muscle insulin sensitivity and reduces stress hormones) yields cumulative glycemic improvements.

3.4.4. Comprehensive TCM Programs

Few trials have simultaneously evaluated all three major TCM modalities, but integrated regimens commonly incorporate multiple approaches in clinical practice. For example, a patient might take an antidiabetic herbal formula for three months,

receive biweekly acupuncture treatments, and attend Tai Chi classes multiple times weekly. Even in the absence of triple-modal RCTs, aggregate data support multi-component programs. A broad review of TCM "non-drug" strategies reported that combined intervention packages—incorporating dietary therapy, prescribed TCM exercises like Qigong, emotional counseling, and acupuncture—consistently produced hypoglycemic effects and improved insulin resistance [33].

Importantly, each modality may target different diabetic complications: Tai Chi/Qigong improves cardiovascular fitness and neurological health; acupuncture has been shown in neuropathy trials to accelerate nerve conduction and reduce neuropathic pain; and herbs may address dyslipidemia or β-cell dysfunction. In one illustrative case series, clinicians reported outcomes for a small cohort of T2DM patients who practiced daily "Baduanjin" Qigong, took a stabilizing herbal tonic (e.g., "Shenqi"), and received monthly acupuncture treatments. After six months, mean HbA1c decreased by ~0.8% with concurrent reductions in HOMA-IR and improved subjective well-being. While such observational examples remain anecdotal, they align with WHO recommendations to integrate traditional exercises and therapies with standard chronic disease care [38].

Table 1 summarizes key outcomes reported for combined TCM interventions in T2DM (changes compared to controls). These examples illustrate measurable improvements in glycemic indices when modalities are used synergistically.

Table 1. Synergistic glycemic benefits of integrated TCM interventions in type 2 diabetes: selected clinical evidence.

Population & Intervention	Duration	ΔHbA1c	ΔFBG	ΔHOMA-IR
N = 20 T2DM; Acupuncture + usual care vs usual care alone	2 wk, 3 treatments	—	−1.2 mmol/L	—
N ≈ 800 T2DM (14 trials); Tai Chi vs usual care/exercise	3 - 24 months	−0.88% [34]	SMD: −0.67	−0.41

Summary of clinical trials assessing the effects of integrated TCM modalities—including acupuncture, Tai Chi, and usual care—on glycemic markers in T2DM patients. Reported outcomes include changes in hemoglobin A1c (ΔHbA1c), fasting blood glucose (ΔFBG), and insulin resistance (ΔHOMA-IR). Negative values represent improvements relative to control. SMD = Standardized Mean Difference. Note: These data demonstrate that combining multiple TCM modalities can lead to meaningful improvements in glycemic control. Reported benefits also include systemic effects such as reduced inflammatory adipokines and improved lipid profiles. Large-scale trials are underway to further evaluate these synergistic outcomes.

3.5. Safety across Modalities

Across included sources, adverse events were generally infrequent and mild. For Chinese herbal medicines, the most common reactions with berberine were gastrointestinal (e.g., nausea, constipation). Meta-analyses indicate no overall increase in the total incidence of adverse events with berberine versus controls (risk ratio ~1.0) [39], and no serious adverse events have been reported in trials (berberine

is considered relatively safe) [40]. Importantly, clinical studies monitoring organ function found no significant changes in liver or kidney safety markers (ALT, AST, creatinine) with berberine compared to placebo [41]. For bitter melon, a 2024 meta-analysis of randomized trials reported no significant changes in ALT, AST, or creatinine versus placebo, supporting short-term tolerability despite neutral glycemic effects [12]. In acupuncture trials, pooled analyses (e.g., in painful diabetic neuropathy) found no discernible difference in adverse-event rates between acupuncture and control/sham [42]. Reported events were typically limited to transient needling pain, mild bruising, or soreness at needle sites, with virtually no serious complications. Similarly, mind-body exercises such as Tai Chi and Qigong are widely characterized as safe and well-tolerated. Overviews of systematic reviews note that adverse events with these exercises are rare and minor [43], often limited to transient musculoskeletal soreness in a few participants. Even long-term Tai Chi programs in older adults with T2DM have been completed with high adherence and minimal adverse issues. This favorable safety profile across modalities is encouraging for their integrative use in diabetes management.

3.6. Limitations

Traditional Chinese medicine interventions for T2DM face several pervasive limitations across the evidence base, affecting herbal medicine, acupuncture, mind-body exercises, and integrated approaches. These methodological concerns raise important questions about the reliability and generalizability of the reported benefits.

3.6.1. Small Sample Sizes and Statistical Power

A substantial proportion of TCM trials suffer from inadequate sample sizes, often enrolling only dozens of participants. For example, a systematic review of TCM for diabetes found an average of only about 66 patients per trial, and notably, no included trial reported a sample size calculation. Such underpowered studies fundamentally undermine statistical power and the robustness of findings. In fact, smaller low-quality trials have been shown to produce exaggerated treatment effect estimates, indicating that reported benefits may be overestimates [44]. Moreover, very small trials may fail to detect important adverse events that could emerge in larger populations, further limiting the conclusions that can be drawn about safety.

3.6.2. Risk of Bias in Study Design

The overall methodological quality of TCM trials is frequently suboptimal. Studies commonly lack rigorous randomization procedures, allocation concealment, or appropriate blinding, resulting in a high risk of bias [45]. Recent quality assessments have revealed concerning patterns. In one analysis of TCM exercise (e.g., Tai Chi) trials, virtually none of the RCTs met "low risk" criteria on standard bias measures, and proper blinding was almost never implemented. For instance, none of the RCTs in a reviewed set explicitly reported using allocation concealment, and only *one*

trial described even single-blinding of participants [46]. This prevalent lack of blinding and other safeguards potentially inflates placebo responses and compromises subjectively reported outcomes. Even objective measures can be influenced when investigators or assessors are not blinded to treatment allocation, underscoring how inadequate trial design can distort efficacy signals.

3.6.3. Inadequate Control Conditions

Many studies employ suboptimal control groups that limit the interpretability of the results. Trials of herbal therapies frequently compare TCM interventions against standard antidiabetic medications or usual care without appropriate placebo controls, making it difficult to isolate specific treatment effects [47]. In fact, a systematic review noted that only 4 trials had placebo controls for Chinese herbal medicine in T2DM, which is insufficient to draw firm conclusions [47]. Similarly, acupuncture trials have often lacked sham acupuncture controls; for example, an overview of acupuncture for diabetic neuropathy found that none of the included trials used a sham procedure as the control [44]. Instead, comparisons were made to active treatments (like vitamins) or no treatment, which cannot fully account for placebo effects [44]. Mind-body exercise studies (Tai Chi, Qigong, etc.) likewise often use weak comparators (such as no exercise or basic diabetes education rather than an active exercise regimen), which may overestimate therapeutic benefits. Without appropriate sham or placebo controls, any efficacy signals must be interpreted with caution, as non-specific effects—including patient expectations and increased clinical attention—could account for the reported improvements.

3.6.4. Heterogeneity in Outcomes and Short Follow-Up Periods

A lack of standardization in outcome measures across TCM studies and generally short follow-up durations also complicates the evidence. Trials variably report fasting glucose, 2-hour postprandial glucose, HbA1c, insulin resistance indices, or subjective "TCM syndrome" scores as primary endpoints, often with inconsistent definitions of "treatment success". This heterogeneity makes it difficult to pool results or compare efficacy across studies. Moreover, most RCTs are too brief in duration, typically lasting only a few weeks to a few months. Such short follow-up periods are inadequate for evaluating a chronic condition like T2DM. A recent analysis noted that the median trial follow-up in this area is under 6 months [48]. Indeed, many TCM trials span ≤ 3 months, which is insufficient to assess long-term glycemic control or the sustainability of any initial improvements. Longer-term outcomes are virtually never reported—one review observed that none of the available TCM trials for diabetes included any meaningful post-trial follow-up to gauge durability of response. This absence of long-term data means that even if short-term metrics improve, it remains unclear whether those benefits persist and whether complications are truly impacted over time [46]. In sum, inconsistent outcome measures and short, insufficient study durations leave significant uncertainty about the long-term efficacy of TCM interventions for

T2DM.

3.6.5. Publication Bias and Language Bias

Substantial concern exists regarding bias in the literature toward positive findings. Trials demonstrating statistically significant benefits are more likely to be published (especially in higher-impact English journals), whereas negative or inconclusive studies often remain unpublished or appear only in local-language journals. Notably, systematic reviews of TCM for T2DM have been dominated by Chinese-language publications, which may disproportionately represent positive results. In one evidence mapping analysis, the majority of included diabetes trials were published in Chinese journals (many not indexed in PubMed), reflecting a strong language bias in the evidence base [47]. Funnel plot analyses from recent meta-analyses often demonstrate asymmetry, suggesting an overrepresentation of smaller studies with extremely positive outcomes [46]. This pattern implies that publication bias (and possibly selective reporting) inflates the apparent efficacy of TCM interventions. Researchers have explicitly acknowledged that negative or null trials are "difficult to report", leading to an unavoidable bias in which trials with no benefit tend not to be published. For example, one systematic review noted it was "*impossible to avoid publication bias, as negative studies were not reported*" in the literature [47]. This systematic bias in the published evidence can grossly skew meta-analytic results and must be kept in mind when interpreting purported benefits of TCM.

3.6.6. Systematic Review Quality and Evidence Grading

Even at the level of systematic reviews and meta-analyses, methodological quality has been problematic. An overview of 18 systematic reviews on TCM for T2DM found variable quality (AMSTAR methodology scores ranging from 3 to 10) and generally low confidence in the evidence according to GRADE criteria. In that analysis, although many reviews claimed positive effects, the actual evidence quality was rated as low or very low in most cases [49]. In other words, favorable conclusions had to be tempered by low certainty. Many reviews included primary studies with a high risk of bias, and their meta-analyses often exhibited substantial heterogeneity in results. Thus, even when systematic reviews report benefits, the strength of the recommendation is undermined by the poor quality of the underlying trials. High-quality evidence—such as large, multicenter RCTs with rigorous controls—remains scarce in the TCM-diabetes literature. Reflecting this, major international health agencies have not endorsed TCM therapies as first-line treatments for diabetes, citing insufficient high-quality evidence. For instance, the U.S. National Institutes of Health (NCCIH) concludes that no herbal supplement or alternative therapy has enough reliable evidence at present to recommend it for diabetes control [50]. Similarly, the World Health Organization has emphasized that traditional remedies must meet the same evidence standards as conventional medicine—establishing efficacy and safety through rigorous clinical trials before they can be widely recommended [51].

4. Discussion

4.1. Comparative Efficacy and Safety of TCM versus Western Therapy

Our comprehensive synthesis indicates that conventional antidiabetic medications generally achieve more substantial glycemic reductions than standalone TCM modalities, but TCM therapies provide meaningful adjunctive benefits with superior safety profiles. For example, meta-analyses demonstrate that Tai Chi and other traditional exercises significantly lower fasting glucose and HbA1c in T2DM patients, with long-term practice outperforming shorter interventions. Similarly, pooled analyses reveal that acupuncture as an adjunctive treatment yields small but statistically significant decreases in fasting blood glucose and improved insulin resistance [52].

While these effects are modest compared to potent pharmaceutical agents, they can help bridge therapeutic gaps when combined with Western medicine. Recent guidelines and trials report enhanced symptom relief and metabolic control when TCM formulas complement standard treatments [53] [54]. Crucially, TCM regimens demonstrate substantially fewer severe adverse effects. Patients treated with herbal or needle therapies typically avoid the gastrointestinal distress, hypoglycemia, and other risks associated with conventional pharmaceuticals [52] [54].

As noted by recent reviewers, "TCM therapies have demonstrated promising results in T2DM clinical studies without causing the types of side effects associated with standard pharmaceutical treatments" [54]. In clinical practice, this safety advantage means that integrative care can leverage the high potency of conventional drugs while using TCM to ameliorate symptoms and enhance overall safety. Our review found few serious adverse events reported from acupuncture or mind-body practices, underscoring their favorable safety profiles [52]. While Western medications remain indispensable for robust glucose control, complementary TCM use can modestly enhance overall efficacy with minimal additional risk.

4.2. Cost, Access, and Patient Adherence

TCM approaches frequently offer economic advantages and may improve patient-centered engagement compared to chronic pharmacotherapy. Herbal remedies and traditional exercises are commonly available and affordable, with recent analyses noting that "the economic burden of TCM diabetes treatments on patients and payers is oftentimes less than that of pharmaceutical regimens" [54]. This cost advantage is particularly relevant in low-resource settings or for patients with limited insurance coverage.

Access is enhanced through non-prescription availability: many herbal ingredients serve dual purposes as foods or supplements, and community-based Tai Chi programs require minimal infrastructure. Adherence patterns also differ favorably. While conventional diabetes regimens demand strict dosing schedules with high nonadherence rates, TCM self-management approaches—such as daily herbal teas or Qigong routines—can be more flexible and integrated into lifestyle patterns, potentially enhancing long-term adherence.

Although formal adherence data remain limited, the holistic, choice-driven nature of TCM—allowing patients to select palatable herbal preparations or preferred exercises—likely encourages sustained engagement. Conversely, some TCM practices, such as frequent acupuncture visits, require commitment that may challenge certain patients. Overall, combining approaches may optimize adherence patterns: patients might use metformin once daily while also performing Tai Chi and taking simple herbal preparations, distributing management tasks across multiple modalities. Thus, integrative care has the potential to improve patient satisfaction and sustained engagement by accommodating individual preferences and resources while maintaining cost-effectiveness [54].

4.3. Mechanistic and Holistic Perspectives

TCM and Western therapies operate through fundamentally different yet potentially complementary paradigms. Western medications are developed to target specific biochemical pathways—such as metformin's inhibition of gluconeogenesis or insulin analogs' targeting of endocrine receptors. In contrast, TCM formulas typically contain multiple active compounds affecting diverse physiological processes. Recent reviews catalog numerous Chinese herbs (ginseng, bitter melon, Rehmannia, etc.) whose mechanisms include enhancing insulin sensitivity, stimulating insulin secretion, protecting pancreatic islets, and inhibiting intestinal carbohydrate absorption [55].

This polypharmacy approach enables TCM to modulate several diabetes-related pathways simultaneously, potentially addressing not only hyperglycemia but also dyslipidemia, inflammation, and microvascular complications concurrently. Additionally, TCM embraces a holistic clinical perspective. Rather than focusing exclusively on numerical glycemic targets, practitioners diagnose "syndromes" and aim to alleviate patients' complete symptom constellation. Our reviewed literature indicates that TCM tends to improve associated complaints—including neuropathic pain, fatigue, gastrointestinal distress, and sleep disturbances—alongside glucose control [53] [54].

This holistic focus manifests in clinical practice: recent Chinese guidelines characterize TCM as part of comprehensive diabetes management models incorporating diet, exercise, herbal prescriptions, acupuncture, and auricular therapy to address quality of life holistically [53]. Such approaches contrast with Western medicine's disease compartmentalization and help explain why many patients perceive unique benefits from TCM interventions. Scientifically, these paradigmatic differences suggest therapeutic synergy: Western agents provide reliable, potent glucose-lowering effects, while TCM may address other aspects of metabolic homeostasis.

Emerging mechanistic research, including metabolomics and network pharmacology studies, is beginning to elucidate how herbal combinations exert multitarget effects, which may eventually enable the rational design of integrative protocols. Nevertheless, evidence quality for some TCM mechanisms remains inconsistent.

As one meta-analysis concluded regarding acupuncture, the magnitude of the effect was statistically significant but small, and long-term benefits on HbA1c or complications remain uncertain [52]. This emphasizes that while TCM insights appear promising, they remain under active investigation.

4.4. Translational Value and Future Directions

The convergence of TCM wisdom with modern technological innovation offers exciting translational opportunities. Digital technologies and artificial intelligence can help integrate vast empirical TCM knowledge with individualized patient data. Recent analyses highlight that AI can revolutionize traditional medicine by enabling personalized treatment plans, predictive analytics, and early disease detection [56]. For diabetes management, machine learning algorithms could analyze electronic health records and biometric data to match patients with optimal herbal formulas or exercise regimens based on unique phenotypic profiles.

AI tools might also optimize the composition of TCM compounds, screening for synergistic herb combinations or identifying safety concerns. This technological promise is already being explored: databases of herbal constituents can be mined algorithmically to predict active ingredients or drug interactions. Similarly, TCM's personalized approach aligns with precision medicine principles. Novel omics approaches are forging these connections: recent work demonstrates how metabolomics and microbiome profiling can translate traditional syndrome patterns into biological biomarkers [57]. In practical terms, patients could be stratified by gut microbiome composition or metabolic phenotype and then receive customized TCM interventions most likely to rebalance those specific pathways. Such multiomics integration may also reveal novel drug targets inspired by herbal constituents.

Another key direction involves addressing aging diabetic populations' unique needs. Older adults frequently experience frailty, polypharmacy, and comorbidities that limit aggressive therapeutic interventions. TCM's generally gentle methods—including Tai Chi, acupuncture, and botanical tonics—are well-suited for geriatric care. Tai Chi exercise has demonstrated significant improvements in glycemic control and physical function among T2DM patients, with superior long-term adherence compared to many strenuous exercises. Acupuncture and herbal treatments, with a low hypoglycemia risk, can be integrated to manage symptoms like neuropathy or cardiovascular aging. Clinicians should explore TCM integration within multidisciplinary geriatric care, using these modalities to maintain mobility, reduce medication burden, and enhance quality of life.

On policy and health system fronts, integrative diabetes management is gaining formal recognition. China now publishes national guidelines that explicitly incorporate TCM into primary care diabetes treatment pathways [53]. This "three disciplines co-management" model has been well-received and may serve as an international template. Globally, there is increasing alignment: major health organizations are preparing to strengthen traditional medicine integration into main-

stream care. Notably, WHO plans to release a new 10-year strategy on traditional and complementary medicine in 2025. This strategy, combined with WHO's recent emphasis on evidence-informed traditional medicine, signals that countries will increasingly be encouraged to standardize and regulate TCM practices. Academic consortia from North America, Europe, and Asia are collaborating to contribute to these policies and establish shared research agendas [58]. In practice, we anticipate expanded availability of quality-controlled herbal products, integrated clinical trials, and reimbursement frameworks covering safe TCM services. Such developments will help translate research findings into population-level health impact.

5. Conclusions

Our comprehensive analysis demonstrates that TCM can serve a valuable supportive role in T2DM self-management. Compared to conventional pharmacotherapy, TCM modalities are generally safer and more cost-effective, and they may enhance treatment adherence and symptom management. However, their standalone glycemic efficacy typically remains modest compared to pharmaceutical interventions. The greatest therapeutic potential lies in integration, leveraging the complementary strengths of both paradigms to deliver more comprehensive, personalized care.

The evidence base, while growing, requires strengthening through more rigorous methodological approaches. Future progress depends on well-designed hybrid trials, interdisciplinary research collaborations, and intelligent application of emerging technologies—including artificial intelligence and multi-omics approaches—to better understand TCM's complex mechanisms. By critically aligning TCM practices with modern scientific standards and healthcare policy frameworks, integrative diabetes management could offer scalable, patient-centered solutions for addressing the global diabetes epidemic.

Ultimately, the integration of evidence-based TCM approaches with conventional diabetes care represents a promising pathway toward more holistic, sustainable, and accessible healthcare delivery. While acknowledging current evidence limitations, healthcare providers and patients may benefit from the carefully considered incorporation of TCM modalities as adjunctive strategies within comprehensive diabetes management plans.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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