



Customized Integrated Management for Non-Insulin Dependent Diabetes Mellitus (NIDDM) and its Complications: Literature Review and Recommendations for the Future Policy Decisions

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Abstract

Background: *Siddha* system of medicine is an ancient medical system practised in Dravidian culture. It mainly focused on dietary and lifestyle recommendations along with medications. Non-Insulin Dependent Diabetes Mellitus (NIDDM) is a metabolic disorder that is characterized by high blood glucose in the context of insulin resistance and impaired insulin secretion. Integrated *Siddha* medicine and modern medicine play a significant contribution in averting and treating NIDDM and its complications. Currently, there is a lack of evidence-supported recommendations for the integrated treatment of NIDDM with *Siddha* and modern medicine. Hence, developing evidence-based recommendations for NIDDM by integrating both medicines is important. **Methods:** This recommendation on therapeutic management for NIDDM is based on the Guidelines issued by the Indian Council of Medical Research (ICMR) for the management of type 2 diabetes mellitus in 2018, *Siddha* Standard Treatment Guidelines on Non-Communicable Disease (NCD), and other published works of literature in Google Scholar, PubMed, EMBASE. The recommendation includes both pharmacological and non-pharmacological management. **Results and Discussion:** This review contains standard recommendations in modern medicine and *Siddha*'s evidence-based recommendations for 9 clinical situations, including recommendations for pre-diabetes, severe diabetes, diabetic prevention, diabetic complications, diabetic foot, and diabetes associated with hypertension. This review also includes *Siddha*'s pharmacological management of single herbs, polyherbal formulations, Herbo mineral formulations, external medicines, and non-pharmacological management like *Yoga* interventions, *varmam* interventions (physical manipulation), etc. **Conclusion:** This review provides a guide to clinicians to manage the patients with NIDDM at various levels of severity and complications. Additionally, long-term, high-quality studies are needed to evaluate the effectiveness of integrative medicine in preventing and treating NIDDM and its complications.

Keywords: Diabetes Mellitus, Integrative Medicine, *Siddha* Medicine

1. Introduction

In 2019, estimates for Non-Insulin Dependent Diabetes Mellitus (NIDDM) or type 2 diabetes, also known as adult-onset diabetes, indicated that 77 million people in India were affected by this metabolic disorder, with projections suggesting a surge to over 134 million by 2045. A version of Type 2 diabetes mellitus has a WHO International Classification of Disease (ICD-11) code

(5A11) which permits healthcare reimbursement¹⁻³. According to WHO, the diabetes prevalence among all Indians and Chinese accounted for diabetes mellitus globally, is rising among young individuals. They have reduced sensitivity to increased insulin secretion⁴.

Nowadays, the simultaneous use of Complementary and Alternate Medicine (CAM) is increasing due to inadequate solutions for newly developing health issues⁵. Approximately 70% of rural inhabitants in

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India place their trust in traditional healing methods as a primary form of health⁶. In traditional medicine, diabetes mellitus is managed with dietary adjustments, physical activity, and medicinal plants. Globally, over 1200 plants are employed for managing diabetes mellitus, with around 30% of these traditionally used antidiabetic plants being pharmacologically and chemically investigated⁷.

The WHO created and introduced the WHO traditional medicine strategy from 2014 to 2023, with a focus on incorporating traditional and complementary medicine into healthcare systems to advance universal healthcare and guarantee the high standards of quality, safety, and efficacy of these medical practices⁸. The world needs affordable, accessible, physiologically compatible traditional medicine and a holistic approach to providing basic healthcare to all. The *Siddha* medicine, which emerged in the southern regions of India, is considered a remarkable accomplishment and a representation of Tamil culture. Nevertheless, the integration of *Siddha* with Modern medicine may be a safe and effective solution for NIDDM⁹. The review aims to investigate the available evidence and recommendations of integrative management for NIDDM and its complications by *Siddha* and modern medical systems.

2. Materials and Methods

Eligibility Criteria: Standard guidelines, peer-reviewed scientific publications, and reports of research projects related to NIDDM, and its complications were only included.

Information source: The Guidelines provided by the Indian Council of Medical Research (ICMR) for the management of type 2 diabetes in 2018, for selected non-communicable Diseases were predominantly taken for the recommendations along with published literature on therapeutic management for NIDDM.

Search strategy: Internet Google search with the terms "Non-Insulin Dependent Diabetes Mellitus/ NIDDM/ Type-2 diabetes/diabetes mellitus/*Neerizhivu/ Madhumegam/Inippuneer*" and "*Siddha*" was done.

Data Collection Process: The review examined the websites of global organizations and private foundations for diabetes. Apart from internet sources, *Siddha*, and scientific literature on diabetes, all original

articles related to diabetes and its complications which were written in English are incorporated in this review.

3. Results

In *Siddha* system of medicine *Inippu Mana Neer/ Neerizivu* (NSMC: XGB1.4)¹⁰ encompasses 20 subtypes of conditions characterized by diverse physical and chemical alterations in urine. It is then categorized into three groups: *Kaba neerizhivu*, *Pitha neerizhivu*, and *Vatha neerizhivu*, each associated with distinct phases of diabetes mellitus. Contemporary medical knowledge also suggests that Type 2 diabetes can transform into Type 1 if left untreated or managed improperly, as indicated in *Neerizhivin patthu avathaigal*¹¹.

This review explores three ways of understanding-standard management, recommendation, and rationale. Disease management available in the ICMR guidelines is considered as the 'Standard' management, therapies and insights available in the *Siddha* literature or integrative published materials or clinical evidence may be considered as a 'Recommendation' and all the supportive points compiled are considered the 'Rationale' (Table 1).

3.1 'Mun-Neerizhivu' (Pre-Diabetes) Management

3.1.1 Standard

Pre-diabetes (HbA1c >5.7%-6.4%) management includes lifestyle changes like a healthy diet, adequate exercise, weight control, and regular screening. Physical activity increases insulin sensitivity and promotes metabolic activity. Metformin can be added if lifestyle changes are rendered insufficient¹².

3.1.2 Recommendation

Along with standard management,

1. *Thiripala Chooranam* tablet
2. Single herbs such as *Coccinia indica*, *Trigonella foenum*, *Aloe vera*, and *Gymnema sylvestre* are recommended for integrative management for pre-diabetics.

3.1.3 Rationale

The pharmacogenetic, physicochemical, and chromatographic analysis of the *Thiripala Chooranam* tablet identifies the starch grain as a polysaccharide that is responsible for the management of pre-diabetes (IGT)¹³.

Table 1. Evidence-based integrated management on Non-Insulin-Dependent Diabetes Mellitus (NIDDM)

S. No.	Clinical Question	Standard Recommendations	Siddha Recommendation for Integrative Management
1	<i>Mun-Neerizhivu'</i> (pre-diabetes) management	<ol style="list-style-type: none"> Lifestyle changes a healthy diet, adequate exercise, and weight control. Metformin can be added if lifestyle changes are rendered insufficient. 	<i>Thiripala Chooranam</i> tablet. Single herbs of <i>Siddha</i> medicines such as <i>Coccinia indica</i> , <i>Trigonella foenum</i> , <i>Aloe vera</i> , and <i>Gymnema sylvestre</i> .
2	<i>Neerizhivu'</i> (diabetes) management	<ol style="list-style-type: none"> Metformin is typically the primary pharmacological treatment for most patients. Sulphonylureas, DPP-4 inhibitors, and SGLT-2 inhibitors are favoured as secondary oral options. For patients not reaching target levels with dual therapy, contemplate triple oral medication or the introduction of insulin. 	Polyherbal combinations and Single herbs can be used to manage <i>Neerizhivu</i> in <i>Siddha</i> <i>Azhinjiyathi kashayam</i> <i>Mathumeha Chooranam</i> <i>Avarai Kudineer Chooranam</i> <i>Thotarchurungi podi</i> <i>Kadalalincil Mathirai</i> <i>Seenthil Mathirai</i> <i>Kadal Azhinjil</i> <i>Triphala Chooranam</i> tablets are recommended.
3	Severe diabetes management	As per ICMR guidelines 2018, when the HbA1c > 9% along with anti-hyperglycemic drugs, insulin should be added to maintain blood glucose.	<i>Ayakandh aabraga chendhuram</i> is a <i>Siddha</i> formulation that possesses an anti-diabetic effect on streptozotocin-induced diabetes in rats.
4	Prevention of diabetes in high-risk patients	<ol style="list-style-type: none"> Efforts to mitigate risk factors associated with diabetes, such as weight reduction or prevention of obesity, aiming to lower the likelihood of developing diabetes in the future. Drugs like metformin, acarbose, troglitazone, pravastatin, ramipril, losartan, and estrogen/progestin have demonstrated efficacy as well. 	<i>Yogasanam</i> <i>Tadasanam</i> , <i>Trikonasanam</i> , <i>Paschimottanasanam</i> , <i>Vajrasanam</i> , <i>Pavanamuktasanam</i> , <i>Bujangasanam</i> , <i>Dhanurasanam</i> , <i>Vakrasanam</i> as postures (<i>asana</i>) <i>Pranayamam</i> <i>Naadisuddhi Pranayamam</i>
5	Management of diabetic complications	<p>Diabetic Nephropathy</p> <ol style="list-style-type: none"> Medications such as Angiotensin Converting Enzyme (ACE) inhibitors or Angiotensin II Receptor Blockers (ARBs). In cases where ACEIs or ARBs are not well-tolerated, alternatives include calcium channel blockers, diuretics, and selective beta blockers. <p>Diabetic Neuropathy</p> <ol style="list-style-type: none"> Maintaining strict glycemic control is crucial. When dealing with painful peripheral neuropathy, primary medications include antiepileptics (such as gabapentin, and pregabalin), Tricyclic Antidepressants (TCAs) (like amitriptyline, and imipramine), and Serotonin and Noradrenaline Reuptake Inhibitors (SNRIs) (such as venlafaxine, duloxetine). For persistent and resistant painful neuropathies, secondary medications like opioids (such as tramadol) are also recommended. 	<p>Diabetic Nephropathy</p> <i>Seenthil Sarkarai (Tinospora cordifolia)</i> <i>Vallathi Ilagam</i> <p>Diabetic Neuropathy</p> <i>Kadukkai Chooranam</i> <i>Seenthil Sarkarai (Tinospora cordifolia)</i> <i>Mimosa pudica</i> <i>D5 Chooranam</i>

Table 1. Continued...

S. No.	Clinical Question	Standard Recommendations	Siddha Recommendation for Integrative Management
6	Diabetic foot management	1. Patients should receive foot care education. In the presence of ulceration, prompt referral to a multidisciplinary foot care service within 24 hours is necessary. If clinical signs of infection are evident, immediate commencement of antibiotics is recommended. 2. If there are clinical indications of severe infection that pose a threat to a limb, urgent admission for intravenous antibiotic treatment and surgical management or referral to specialized medical centres is essential.	Internal medicine <i>Capsule Rasaganthi Mezhu</i> <i>Parangipattai Mathirai</i> <i>Seenthil Sarkarai</i> <i>Palagarai parpa mathirai</i> External Medicine <i>Padigara neer</i> for wash <i>Mathan thylam</i> . <i>Manjal karasealai</i> <i>Maththan Thailam, Palagarai Parpam</i> and <i>Muthuchippi Parpam</i> for external application are recommended
7	Management of adhesive capsulitis associated with diabetes	1. NSAIDs and other pain-relieving medications, corticosteroids, oral steroids, and local steroid injections are commonly employed. 2. Calcitonin reduces the systemic inflammatory response and promotes the release of endorphins. 3. Surgical procedures such as treatment under anaesthesia or Arthroscopic Capsular Release (ACR) may be considered.	1. <i>Siddha Varmam</i> therapy <i>Mudichi Varmam, Kaakkattai Kaalam, Enthi Kaalam, Piratharai Kaalam, Kaikootu Varmam, Manibandha Varmam, Manjadi Varmam, Kavuli Kaalam, Savuu Varmam, Sevikutri Varmam</i> 2. <i>Siddha Thokkanam</i> therapy with <i>Vathakesari thailam</i>
8	Management of hypertension associated with diabetes	1. The initial approach involves weight reduction, adjusting the diet by lowering salt intake, and implementing stress management techniques. 2. A single medication option includes either ACE inhibitors or ARBs (but not both), alternatively, calcium channel blockers, selective beta-blockers, or diuretics can be considered.	<i>Neermulli Kudineer</i> is recommended. <i>Jatamansi (Nardostachys jatamansi)</i> <i>Chooranam</i> is recommended.
9	Delaying diabetes progression	Research indicates that Metformin delays the advancement of Type 2 Diabetes Mellitus (T2DM), lowers the likelihood of complications, and diminishes death rates among patients. This is achieved by suppressing hepatic glucose production (gluconeogenesis) and enhancing insulin sensitivity in peripheral tissues.	<i>Madumegam Kudineer Chooranam, Seenthil Chooranam, Triphala Chooranam</i> , along with Yogic practices are recommended.

A clinical study investigates 36 herbal remedies in a cohort of 4,565 individuals with diabetes or impaired glucose tolerance. It showed the best efficacy of single herbs such as *Coccinia indica*, *Gymnema sylvestre*, *Aloe vera*, and *Trigonella foenum*¹⁴.

3.2 'Neerizhivu' (Diabetes) Management

3.2.1 Standard

1. Metformin is typically the primary pharmacological treatment for most patients.
2. Sulphonylureas, DPP-4 inhibitors, and SGLT-2 inhibitors are favoured as secondary oral options.
3. For patients not reaching target levels with dual therapy, contemplate triple oral medication or the introduction of insulin¹².

3.2.2 Recommendation

Polyherbal combinations and single herbs can be used to manage *Neerizhivu* in *Siddha*

1. *Azhinjiyathi kashayam*¹⁵
2. *Mathumeha Chooranam*
3. *Avarai Kudineer Chooranam*
4. *Thotarchurungi podi*
5. *Kadalalincil Mathirai*
6. *Seenthil Mathiri*¹⁶
7. *Kadal Azhinjil*
8. *Triphala Chooranam* tablets¹⁷ are recommended.

3.2.3 Rationale

A clinical study carried out on *Azhinjiyathi kashayam*, a polyherbal formulation, demonstrated its effectiveness in

lowering blood sugar levels in patients with *Madhumeagam* (Type-2 diabetes). No adverse drug reactions were observed during the extended administration in diabetic patients. The ingredients of the *Mathumeha Chooranam* (MMC) possess antioxidant activity¹⁸. In an open-label, non-comparative, non-randomized phase IV clinical trial involving 95 participants¹⁹, findings indicated a major decrease in fasting ($p = 0.046$), PPBS ($p < 0.001$), and HbA1c ($p < 0.001$) levels following MMC intervention. A Clinical trial demonstrated a significant reduction in clinical conditions such as polyuria, polyphagia, and polydipsia along with changes in blood glucose levels among the patients treated with *Siddha* medicines *Avarai Kudineer churnum*, *Thotarchurungi podi*, *Kadalalincil Mathirai*, *Seenthil Mathirai*. A clinical trial showed a remarkable reduction in blood sugar in cases treated with *Kadalazhinjil* and *Triphala* tablets.

3.3 Severe Diabetes Management

3.3.1 Standard

As per ICMR guidelines 2018, when the HbA1c > 9% along with anti-hyperglycemic drugs, insulin should be added to maintain blood glucose¹².

3.3.2 Recommendation

Siddha herbs-mineral medicine *Ayakaandha Abraga Chendhuram* (AAC) is recommended as the preferred medication for severe diabetes management.

3.3.3 Rationale

Ayakandha Abraga Chendhuram (AAC) was evaluated for its antidiabetic effect on streptozotocin-induced diabetes in rats. The results showed the drug has hypoglycaemic activity. Administration of medication (25mg/kg) considerably decreases the blood glucose range as the duration of drug administration increases²⁰.

3.4 Prevention of Diabetes in High-risk Patients

3.4.1 Standard

Efforts to mitigate risk factors associated with diabetes, such as weight reduction or prevention of obesity, aim to lower the likelihood of developing diabetes in the future¹². For individuals at elevated risk of diabetes, such as older adults, dietary and exercise interventions have demonstrated significant reductions in diabetes

incidence. While medications like metformin, acarbose, troglitazone, pravastatin, ramipril, losartan, and estrogen/progestin have shown effectiveness, their benefits in older populations are not always evident. The adoption of lifestyle modifications across all age groups could substantially mitigate the growing diabetes epidemic²¹.

3.4.2 Recommendation

3.4.2.1 Yogasanam

Tadasanam, *Trikonasanam*, *Paschimottanasanam*, *Vajrasanam*, *Pavanamuktasanam*, *Bujangasanam*, *Dhanurasanam*, *Vakrasanam* as postures (*asana*)

3.4.2.2 Pranayamam

Naadisuddhi Pranayamam^{22,23}

3.4.3 Rationale

A review of Yoga research revealed that Yoga such as *Surya namaskaram*, *Tadasanam*, *Trikonasanam*, *Paschimottanasanam*, *Vajrasanam*, *Pavanamuktasanam*, *Bujangasanam*, *Dhanurasanam*, *Vakrasanam* as postures (*asana*) and breathing techniques, *pranayamam*^{22,23}. Exercise is crucial in preventing and managing Type 2 Diabetes Mellitus (T2DM) by regulating weight, controlling blood pressure, glycemic levels, lipid profile, and decreasing oxidative stress.

3.5 Management of Diabetic Complications

3.5.1 Standard

Macrovascular complications such as coronary artery disease and peripheral vascular disease, as well as microvascular complications like diabetic retinopathy, neuropathy, and nephropathy, need to be observed.

3.5.2 Diabetic Nephropathy

- Medications such as Angiotensin-Converting Enzyme (ACE) inhibitors or Angiotensin II Receptor Blockers (ARBs).
- In cases where ACEIs or ARBs are not well-tolerated, alternatives include calcium channel blockers, diuretics, and selective beta blockers.

3.5.3 Recommendation

- *Seenthil Sarkarai* (*Tinospora cordifolia*)
- *Vallathi Ilagam*

3.5.4 Rationale

The nephroprotective effect of *Tinospora cordifolia* lowers blood glucose levels, regulates renal parameters, reduces cytokine levels, and decreases mRNA expression levels of various genes associated with diabetic nephropathy²⁴. Administration of *Semecarpus anacardium* resulted in reductions in urea, uric acid, and creatinine levels. It significantly lowered marker enzyme and lipid peroxide levels while boosting antioxidant enzyme levels. Moreover, histopathological abnormalities in kidney tissues were observed to be restored following treatment with SA nut milk extract²⁵.

3.5.5 Diabetic Neuropathy

- Maintaining strict glycemic control is crucial. When dealing with painful peripheral neuropathy, primary medications include antiepileptics (such as gabapentin, and pregabalin), Tricyclic Antidepressants (TCAs) (like amitriptyline, and imipramine), and Serotonin and Noradrenaline Reuptake Inhibitors (SNRIs) (such as venlafaxine, duloxetine).
- For persistent and resistant painful neuropathies, secondary medications like opioids (such as tramadol) are also recommended.

3.5.6 Recommendation

- *Kadukkai Chooranam*
- *Seenthil Sarkarai (Tinospora cordifolia)*
- *Mimosa pudica*
- *D5 Chooranam* is recommended for diabetic complications.

3.5.7 Rationale

"*Kadukkai Chooranam*" for "*Akkini selathumam*" (diabetic neuropathy) showed that the neuropathic pain score decreased from 6.9 to 2.7. Fasting blood sugar was from 171 to 151 while postprandial blood sugar was reduced from 213 to 172. HbA1C decreased from 8.7 to 8.18 on average. HDL levels increased from 43 to 50, while average LDL levels decreased from 146 to 109, accompanied by reduced values of triglycerides from 207 to 142. The BMI ratio decreased from 25.00 to 24.67, indicating effective weight management²⁶. Research conducted by Grover *et al.* demonstrated the alleviation of experimental diabetic neuropathy through

the administration of *Tinospora cordifolia* at a dosage of 400mg/kg body weight. *Tinospora cordifolia* exhibits aldose reductase inhibition, which was observed to alleviate pain and improve motor and sensory nerve conduction velocities²⁷. A review article showed that *Mimosa pudica* is traditionally utilized for diverse purposes, including the management of complications related to diabetes, it also has hypolipidemic, anti-oxidative, and wound healing activity²⁸. The anti-diabetic activity of synergistic compound D5 was assessed in diabetic rats induced by streptozotocin and exhibited a notable decrease in Fasting Blood Glucose levels (FBG), blood urea, creatinine, serum total cholesterol, and triglycerides. Histopathological study of the pancreas of rats showed regeneration of cells of islets of Langerhans. Another study on open-labeled, multi-centric clinical trials in diabetes patients showed significant improvement in HbA1c and postprandial glucose levels²⁹.

3.6 Diabetic Foot Management

3.6.1 Standard

- Patients should receive foot care education. In the presence of ulceration, prompt referral to a multidisciplinary foot care service within 24 hours is necessary. If clinical signs of infection are evident, immediate commencement of antibiotics is recommended.
- If there are clinical indications of severe infection that pose a threat to a limb, urgent admission for intravenous antibiotic treatment and surgical management or referral to specialized medical centres is essential¹².

3.6.2 Recommendation

Internal medicine

- *Rasaganthi Mezhugu*
- *Parangipattai Chooranam*
- *Seenthil Sarkarai*
- *Palagarai parpam*

External medicine

- *Padigara neer* for wash
- *Mathan thylam*³⁰
- *Manjal karasealai*³¹
- *Maththan Thailam, Palagarai Parpam, and Muthuchippi Parpam* for external application are recommended³².

3.6.3 Rationale

Siddha combination therapy (*Rasaganthi Mezhu*, *Parangipattai Chooranam Mathirai*, *Seenthil Sarkarai*, *Palagarai parpam*, *Padigara neer* for wash, *Mathan thylam*)³² showed a significant reduction in pain, discharge, and peri-wound area which were measured using diabetic ulcer severity score. A case study chronic wound on the right foot that was treated with *Manjal Karasealai* showed features of complete healing. A case series of six patients with chronic non-healing ulcers treated with topical application of *Siddha* medicine *Maththan Thailam*, *Palagarai Parpam*, and *Muthuchippi Parpam* for 6 weeks showed significant improvement measured by Leg Ulcer Measurement Tool (LUMT). At the end of treatment, none of the ulcers exhibited necrotic tissue, leg oedema, or peri-ulcer skin involvement.

3.7 Management of Adhesive Capsulitis Associated with Diabetes

3.7.1 Standard

- NSAIDs and other pain-relieving medications, corticosteroids, oral steroids, and local steroid injections are commonly employed.
- Calcitonin reduces the systemic inflammatory response and promotes the release of endorphins³³.
- Non-surgical treatment for frozen shoulders achieves success in around 90% of patients, with only a small percentage necessitating surgical interventions like treatment under anaesthesia or Arthroscopic Capsular Release (ACR).

3.7.2 Recommendation

- *Siddha Varmam* therapy
Mudichi Varmam, *Kaakkattai Kaalam*, *Enthi Kaalam*, *Piratharai Kaalam*, *Kaikootu Varmam*, *Manibandha Varmam*, *Manjadi Varmam*, *Kavuli Kaalam*, *Savuu Varmam*, *Sevikutri Varmam*³⁴
- *Siddha Thokkanam* therapy with *Vathakesari thailam*

3.7.3 Rationale

In the *Siddha* system of medicine, adhesive capsulitis, referred to as *Kumbavatham*, is addressed through *Siddha Varmam* therapy and *thokkanam* with *Vathakesari thylam*. This combined therapeutic

approach has resulted in diminished pain and improved range of motion, assessed through a goniometer and the SPADI index.

3.8 Management of Hypertension Associated with Diabetes

3.8.1 Standard

- Blood pressure exceeding 140/90 mmHg serves as the threshold to commence treatment. Initial efforts should focus on managing blood pressure through non-pharmacological methods, including weight reduction, dietary adjustments to reduce salt intake and stress management.
- If blood pressure remains above 140/90 mmHg, a recheck after one week is recommended. If hypertension persists, pharmacological intervention becomes necessary, typically starting with a single medication such as ACE inhibitors/ARBs (avoiding combination therapy), calcium channel blockers, selective beta-blockers, or diuretics (as a third-line treatment if warranted).
- Should blood pressure remain elevated (>140/90 mmHg) after one month of monotherapy, the addition of a second medication from a different class is advised (avoiding a combination of ACEI and ARB). If blood pressure remains uncontrolled even with the two agents, transfer to an expert is warranted.
- If the initial blood pressure reading is greater than 180/110 mmHg or if the patient presents with an indication of end-organ damage, initiation of management with two medications is recommended, with prompt referral to a specialist¹².

3.8.2 Recommendation

- *Neermulli Kudineer* is recommended.
- *Jatamansi (Nardostachys jatamansi) Chooranam* is recommended.

3.8.3 Rationale

Treated with *Neermulli kudineer* showed a significant reduction in Microalbuminuria (MAU) 17.6 ± 12.2 ($p < 0.001$), Systolic Blood Pressure (SBP) 137 ± 10.81 ($p < 0.001$) and Diastolic Blood Pressure (DBP) 87 ± 7.33 ($p < 0.001$)³⁵. The powdered dried rhizome of *Nardostachys jatamansi (Chooranam)*. Following 8

weeks of treatment, there was a statistically major decrease in Systolic Blood Pressure (SBP) to 123.24 ± 0.35 mm Hg and Diastolic Blood Pressure (DBP) to 80.16 ± 0.27 mm Hg³⁶.

3.9 Delaying Diabetes Progression

3.9.1 Standard

Metformin has been demonstrated to delay the progress of Type 2 Diabetes Mellitus (T2DM), diminish the likelihood of complications, and lower death rates in patients by inhibiting hepatic glucose synthesis (gluconeogenesis) and enhancing insulin sensitivity in peripheral tissues. Additionally, it enhances insulin sensitivity by promoting insulin receptor expression and augmenting tyrosine kinase activity. Latest research furthermore suggests that metformin reduces plasma lipid levels via activation of the Peroxisome Proliferator-Activated Receptor (PPAR)- α pathway, thereby mitigating cardiovascular diseases (CVDs). It's suggested that metformin might cause slight weight reduction in overweight and obese individuals who are prone to diabetes by triggering actions like incretin through Glucagon-Like Peptide-1 (GLP-1) mediation³⁷.

3.9.2 Recommendation

- *Madumegam Kudineer Chooranam*
- *Seenthil Chooranam*
- *Triphala Chooranam* along with *Yogic* practices are recommended.

3.9.3 Rationale

An observational study on ten subjects with T2DM using *Siddha* medications *Madumegam Kudineer Chooranam*, *Seenthil Chooranam*, *Triphala Chooranam*, along with *Yogic* practices has shown a major decrease in FBG, PPBG, and HbA1c along with the reduction of allopathic medications³⁸.

4. Discussion

Given the National Health Policy, 2017³⁹ recommendation to integrate the *Ayush* system with modern medicine in treating NCDs, the paper explores to lay foundations for research and policy decisions. The modern system has its established standards and evidence-based traditional medicines as its uniqueness and peculiarity

in treating diseases. Taking the established standards of modern medicines and blending them with the peculiarity of the evidence-based traditional *Siddha* treatment practice can result in better integrative and customised treatment for every individual. The rise in non-communicable diseases, drug resistance, and pharmaceutical side effects, along with increasing dissatisfaction with the effectiveness of some biomedical treatments, has led to a heightened focus on Traditional, Complementary, and Alternative Medical (TCAM) systems.

The paper discusses different stages of NCD-DM and its complications. Though both systems have standalone treatments and their effectiveness, the integrated approach has much more enhanced benefits and better outcomes. The integrated approach suggests potential increases in the bioavailability of the drug, reduces the side effects, and treatment durations, and reduces complications. The global economic burden of NCDs is estimated to rise to \$13 trillion by 2030⁴⁰. While comparing the economic burden of modern medicine and *Siddha* or Traditional Medicine (TM), TM will be affordable to the patients for two major reasons, the bio-enhancing activity of drugs in *Siddha*/TM medicines and the lower number of non-mediators in TM practice. Bio-enhancement offers several advantages, including enhanced bioavailability and effectiveness, decreased occurrence of adverse drug reactions or side effects, improved oral absorption of various nutrients like vitamins, minerals, and amino acids, lowered drug resistance, reduced need for raw materials in drug production, leading to economic benefits through lower costs of dosage forms and overall treatment expenses⁴¹. Also, nearly 40% of cost decreases due to the lower number of non-mediators available in TM practice. Assessing health insurance records can serve as an efficient method to gauge whether there are cost reductions associated with the utilization of traditional or complementary healthcare services. A retrospective analysis of Quebec health insurance records explored that the estimated cost saving due to non-mediators was as much as \$300 million per year⁴².

However, there is a requirement for well-defined clinical practice guidelines to educate clinicians and patients about the evidence supporting or discouraging the utilization of integrative therapies from *Siddha* and modern medicine for specific outcomes in

the treatment of NIDDM, including symptom management. This recommendation covers the *Siddha* integrative management for pre-diabetes, diabetes, complications of diabetes, diabetic associated diseases. These recommendations will be helpful in increased research-related projects in the integrative aspect and policy decisions in public health practices.

5. Conclusion

Diabetes is a worldwide problem that impacts one in every eleven persons nowadays. Many innovative therapies and treatments are considered the diabetes management. The ancient methodology with a modern approach is also the way of good sign for public health. Proper recommendations or guidelines are essential for good integrative clinical practice, these recommendations are the preliminary move on the road to an integrative healthy society.

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