IJCRR
Section: Healthcare
Sci. Journal Impact
Factor: 6.1 (2018)
ICV: 90.90 (2018)

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Complementary and Alternative Medicine in Association with Type 2 Diabetes Mellitus

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ABSTRACT

Background: Type 2 Diabetes Mellitus is a clinical condition that is associated with energy metabolism, particularly carbohydrate and fat management in the organism. An increase in the prevalence of diabetic population and the association of decreasing patient compliance and medication adherence leads to prefer a new concept for the management of disease complications. The use of complementary and alternative medicine (CAM) has proved to be effective for controlling diabetes.

Objectives: The purpose of this review is to perform an overview of CAM use, to emphasize its importance for managing diabetic complications and to get outfits of CAM.

Discussion: A literature survey was done by using various articles related to CAM and Diabetes mellitus. The focus was kept on the frequency of CAM use, the methods they use, the factors related to the use of CAM, the sources of information about CAM treatment, and the effect of the method used for disease management.

Conclusion: This review concluded that CAM therapy found to have adept at reducing blood glucose, maintaining a healthy body, and relieving symptoms of DM. From the study, the relevance of CAM for managing Diabetic complications was verified and the future need to perform scientific researches on CAM use was analyzed.

Key Words: Complementary And Alternative Medicine, Type 2 Diabetes Mellitus, Nutraceuticals, Mind-body interventions, Health

INTRODUCTION

Type 2 Diabetes Mellitus is a disease condition that is linked to energy metabolism, particularly carbohydrate and fat management in the organism⁴. In the last decades, there was an explosive increase in the number of people diagnosed with diabetes worldwide due to ageing as well as the increasing prevalence of obesity and physical inactivity^{5,7}. The total number of people with diabetes is projected to rise from 347 million in 2008⁷ to 552 million in 2030 as per data⁸.

Along with total energy intake macroelements as well as microelements are playing a role to show various types of serious effects of diabetes mellitus. From clinical findings data is suggestive of individual vitamins e.g. A⁹, B1¹⁰, B3¹¹, C^{12,13}, D¹⁴ and E¹⁵, minerals e.g. calcium¹⁶, magnesium¹⁷ and trace elements e.g. zinc¹⁸, chrome¹⁹ beneficially affect the complications of diabetes mellitus.

Although medical advancements are there, therapeutic outcomes are often unreachable. An unsatisfied population can shift to nontraditional medicine or further alternatives. Many professionals considered Complementary and alternative medicine as the best option for minimizing diabetic complications. Therefore, this study focuses mainly on complementary and alternative medicine utilization in diabetic complication management.

Complementary and alternative medicine

Complementary and alternative medicine (CAM) can be defined as an alternative health-care approaches besides mainstream Western, or conventional medicine. It reflects two words, “complementary” meaning used together with, and “alternative” meaning used in place of conventional medicine¹⁹. As per the guidelines from National Center for Complementary and Alternative Medicine (NCCAM) ¹, Na-

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ISSN: 2231-2196 (Print)

ISSN: 0975-5241 (Online)

Received: 01.06.2020

Revised: 17.07.2020

Accepted: 12.08.2020

Published: 08.09.2020

tional Institutes of Health defines complementary and alternative medicine as “health care approaches with a history of use or origins outside of mainstream medicine.”

Objectives

The purpose of this review is

- To present an overview of the use of complementary and alternative therapies in association with diabetes.
- To emphasize the importance of CAM for the management of diabetes and reducing its complications.
- To obtain the benefits of various therapies involved in CAM approaches.

Categories

As per the National Center for Complementary and Alternative Medicine, CAM therapies are broadly categorized into two main categories like I) Natural therapies and II) Mind-body intervention^{1,3}.

Natural therapy or biological-based therapies

Certain conditions like infections, microvascular and macrovascular complications of diabetes may occur due to deficiencies of the microelements, vitamins, and nutrients. Such events can be minimized by the administration of these essentials. Vitamins and minerals proved helpful for the enhancement of the immune status of patients so they can easily overcome the clinical conditions. Biologically based therapies indicate substances coming from nature that includes herbs, essential oils, typical diet, nutritional and food supplements, and other products such as cartilage²⁰.

The following are some findings obtained from natural therapy utilization for CAM significance and outcomes obtained from them as mentioned in table no.1.

Table 1: Clinical trials showing CAM significance and outcomes

Neutropceuticals	Clinical findings
Vitamin A	Type 2 diabetics of elderly age group showed low plasma concentrations of vitamin A and carotenoids ⁴ , with lower carotene and higher RBP than controls, the study done by administering retinoic acid in diabetic mice has been shown to reduce RBP4 (Retinol binding protein 4), as well as the reduction in retinol to RBP4 ratio, and found to improve insulin sensitivity ³² .
Vitamin B6	In humans, the combination of pyridoxine with thiamine has been shown to decrease DNA glycation in leukocytes of diabetic patients ⁴ .
Niacin	Niacin administration in the diabetic population results in the reduction of monocyte adhesion to endothelial cells ⁴ .

Table 1: (Continued)

Neutropceuticals	Clinical findings
Biotin	A study on biotin and chromium picolinate supplementation that showed anti-diabetic effects in type 2 diabetic rats, and appear to prevent insulin resistance in skeletal muscle by an increase in the expression of the glucose transporter protein GLUT4 ^{30,31} .
Cyanocobalamine	In type 2 diabetes due to oxidative stress deficiencies of vitamin B12 and folic acid results in hyperhomocysteinemia ⁴⁰ , which may further result in peripheral neuropathy ⁴¹⁻⁴⁵ .
Folate, Folic Acid or B9	Folic acid level reduction in type 2 diabetes patient's sound to be associated with vitamin B12 deficiency and consequent hyperhomocysteinemia. Supplementation of pyridoxine, folate, and vitamin B12 are also associated with the development of positive effects in diabetic retinopathy patients ²⁹ .
Vitamin C or Ascorbic Acid	From the study Glycosylated haemoglobin, fasting, and postprandial blood glucose, and oxidative stress showed the inverse correlation with plasma vitamin C concentration. Vitamin C has also been shown to reduce anxiety levels in diabetes. Three-month supplementation of vitamins C and E decreases hypertension, blood glucose while increasing superoxide dismutase and glutathione levels ⁴ .
Vitamin D	The expression of calbindin-D28K has demonstrated a protective effect on beta cells from cytokine-mediated cell death, reducing the risk of T2DM.
Vitamin E	The effect of vitamin E on risk of diabetes and its complications is most probably due to its role as an antioxidant; a decrease in plasma tocopherol was noted in diabetic patients with chronic state relates to total cholesterol, central type obesity, lipid peroxidation, and cardiovascular complications.
Vitamin K	Vitamin K affects insulin sensitivity, glucose metabolism in diabetes.
Multivitamin	In the study of multivitamin effect in type 2 diabetes patients, the study population was administered with multivitamins and minerals for one year resulted in reduced incidence of infections in patients with subclinical micronutrient deficiency ⁴ .

Data was obtained from articles showing Clinical trials conducted on herbs like Cinnamon [*Cinnamomum verum*],

bitter gourd [*Momordica charantia*], fenugreek [*Trigonella foenum-graecum*], Crepe Ginger [*Costus speciosus*] and ivy gourd [*Coccinia grandis*]. Clinical outcomes and mechanisms of the antidiabetic effect of these herbs were summarized and mentioned in table no.2.

Table 2: Clinical outcomes and mechanisms of the antidiabetic effect of herbs

Herb	The mechanism utilized in diabetes
<i>Cinnamomum Verum</i> Cinnamon	Cinnamon facilitates glucose entry into cells by increasing the amount of GLUT4 [Glucose transporter type 4] receptors, Insulin Receptor (IR), and Insulin Receptor substrate ^{40,41} . Cinnamon increases the expression of PPAR [Peroxisome proliferator-activated receptors] (alpha) and PPAR (gamma), that help to improve insulin sensitivity ⁴² .
<i>Momordica charantia</i> (MC) (Bitter gourd or bitter melon)	MC extract increases cellular glucose uptake by enhancing cellular insulin signalling pathways through up-regulation of GLUT 4 [Glucose transporter type 4] and PI3K [Phosphoinositide 3-kinase], as well as up-regulating PPAR [Peroxisome proliferator-activated receptors] gamma, MC preserves islet beta cells and has shown to stimulate glycogen storage by liver and insulin secretion by islets of Langerhans ^{43,44} .
<i>Trigonella foenum-graecum</i> (Fenugreek)	Fenugreek helps diabetic patients by enhancing glucose uptake into the cells and also by stimulating the tyrosine phosphorylation of the insulin receptor ⁴⁵ .
<i>Costus speciosus</i> (Crepe Ginger)	The Hypoglycemic effect was accompanied by an increased hepatic hexokinase activity and liver glycogen content in diabetic rats.
<i>Coccinia grandis</i> (Ivy gourd)	Pectin, isolated from the fruit of <i>Coccinia grandis</i> has hypoglycemic properties in rats ⁴⁶ by correcting elevated levels of glucose-6-phosphatase and lactate dehydrogenase ⁴⁷ . The plant extract found to increase activation of peroxisome proliferator-activated receptor-gamma activity ⁴⁸ . Triterpenes, isolated from <i>Coccinia spp</i> may have the ability to reverse beta-cell damage induced by Alloxan in experimental diabetic rats ⁴⁶ .

Mind-body therapies

The therapies including holistic perspectives or mind body spirit evaluation techniques to enhance the mind's ability to affect body functions and symptoms are known as mind-

body therapies. Its broad category approach to be considered to include various therapies like visualization, guided imagination, progressive muscle relaxation, meditation, prayer, music therapy, light therapy, art therapy, journaling, storytelling, biofeedback, hypnosis, humour, animal-assisted therapy, tai chi, qigong, and yoga²⁰.

Manipulative and body-based therapies

Application of pressure for manipulation or movement of one or more body parts can be considered in this therapy. The following are some examples that can interpret the idea of manipulative and body-based therapies as chiropractic medicine, osteopathic manipulative medicine, movement therapy, and Rolfing i.e. a form of soft-tissue manipulation²⁰.

Energy therapies

This kind of complementary and alternative medicine works on the belief that a vital energy flows through the human body. They aimed to balance the energy flow in the patient by modification, manipulation, enhancement, and supporting the energy fields for reducing stress, anxiety, and promotion of well being²¹. Energy therapy can be known by various names as per various regions and by different countries and considered to work by light therapy or energy infusion therapy^{1,23}. Energy therapies may include healing touch, therapeutic touch, Reiki, acupuncture or acupressure, and reflexology¹. A data on randomized controlled trial in patients with diabetic peripheral neuropathy, foot reflexology resulted in a reduction of A1C and FPG, and improve pain scores along with nerve conduction velocity³⁹.

Traditional Chinese Medicine

Traditional Chinese medicine work as a holistic system consisting of a combination of natural medicines, massage therapy, diet changes, acupuncture, and some practices like breathing exercises, movement therapies, and mind stabilizing therapies¹⁹.

Systems of Care

There are some categories of treatment which become distinct from other approaches of disease management that shows their work based on systems of care like homoeopathy, Ayurveda, Chinese medicine, a folk system of medicine and can be proved to be effective for improving the health status of the patients^{1,21}.

Yoga

Yoga consists of various exercises, asanas, and meditation. Yoga harmonizes the body with our mind and breath. It identifies one with different levels of consciousness and understanding resulting in gaining perspective and peace. Yoga interns proved to obtain a healthy mind and a healthy body. In the case of the diabetic population some studies on yoga

for reducing complications type 2 diabetes showed better effects of controlling glycemic levels, regulation of lipid and BP profile, again to reduce A1C, fasting, and postprandial glucose values¹⁹.

DISCUSSION

An article among Non-Hispanic White, Mexican American, and Vietnamese American Type 2 Diabetic Patients on Complementary and Alternative Medicine (CAM) Use concluded that CAM use may result in improved diabetes management with long-term health outcomes as per race and ethnicity. It also reflected Low levels of thiamine and increased renal clearance in both Type 1 and type 2 diabetic patients. Better clinical outcomes found to be obtained on thiamine supplementation among those patients.

The association between diabetes and bacterial infection has been recognized for many years^{25, 26}. A prospective study showed a higher incidence of bacteremia in diabetic patients compared to non-diabetics. Surgical wound infection may also be associated with diabetes mellitus. In a study calculating rate of wound infection for total hip replacement surgeries among diabetic and nondiabetic populations with similar circumstances found to obtain a higher percentage for diabetic people and a very low fraction for non-diabetics. In the study i.e. Effect of Antioxidants and B-Group Vitamins on Risk of Infections in Patients with Type 2 Diabetes Mellitus, the provision of nutrient supplementation to diabetic subjects was done and improvement in the disease-related complications was noted²⁷. In some studies relating to vitamin D and chronic inflammatory status of T2DM patients, outcomes helped to conclude that vitamin D acts on inflammatory mediators and modulates the effects of mediators like cytokines and nuclear tran-

scription factors such as NF- κ B. This results in improving insulin sensitivity and promoting pancreatic β -cell survival²⁸.

Studies on Systems like yoga, tai chi showed an effect on glycemic control in people with type 2 diabetes and in lowering A1C levels¹⁹.

In a preclinical study for outcomes of nutrient therapy for the management of diabetes, it was reported that external supplementation like Calcium, zinc, chromium, magnesium, vitamins found to increase insulin sensitivity, reduced vascular resistance and induced partial regurgitation, increased HbA1c, fasting glucose and insulin level, decreased lipid peroxidation, reduction in serum triglycerides, and VLDL reduction in type 1 and type 2 diabetes.

CONCLUSION

Total of 18 articles relating to complementary and alternative medicine was included in the study, out of which 4 reviews found to be showing the significance of CAM for the reduction of blood glucose level, improving insulin utility, and minimizing diabetic complications. One preclinical study on diabetic rats indicates Diagnostic parameters improved in MVT treated male rats but not in streptozocin treated female rats. In another prospective observational study, varying rates of CAM use were analyzed. A descriptive cross-sectional study containing differential statistical questionnaires came with outcomes as Herbs proved to be effective for reducing blood glucose, maintaining a healthy body, and relieving symptoms of DM. As such numbers of studies were taken into consideration for finding the beneficial outcomes for utilization as well as finding safety parameters of CAM for managing diabetic complications. Some of which are shown in table no 3.

Table 3: Different clinical trials showing CAM significance in the diabetic population

Articles	Type of study	Study parameters	Clinical outcomes
Uslu et al. 2018, 7:1	Review	CAM for children with T1DM	Use of CAM reduces diagnosis duration, lowers blood glucose level, improves insulin utility, minimizes diabetic complications
Sarkozy et al. 2014, 14:72	Preclinical case-control study	MVT administration in diabetic rats	Diagnostic parameters improved in MVT treated male rats but not in streptozocin treated female rats
Khalaf et al. 2010, 10:35	Prospective observational study	CAM use for Diabetes	High rates of CAM users for managing diabetes
Niswah et al. 2014	A descriptive, cross-sectional study	Differential statistical questionnaire for herb use	Herbs proved to be effective for reducing blood glucose levels, maintaining proper health, and relieving symptoms of DM
Medagama et al. 2014, 13:102	Review	Cinnamon, bitter guard, fenugreek, crepe ginger, ivy guard as a CAM	Effects of 5 CAM for minimizing diabetic complications

Table 3: (Continued)

Articles	Type of study	Study parameters	Clinical outcomes
Debra Kramlich. 2014, 6	Research article	CAM use and significance	To emphasis the benefits of nonpharmacologic therapies for critically ill patients
L.D. Grossman et al. 2018, 42	Case-control study	NHP and CAM	Reduction of co-morbidities and complications of diabetes, including lipids and blood pressure (BP) in diabetes, as well as CVD, nephropathy, retinopathy and peripheral neuropathy
Valdes Ramos et al. 2015, 15	Review	Vitamins and Type 2 Diabetes Mellitus	Neutropceuticals shows effectiveness for management of C-reactive protein, HDL cholesterol, triacylglycerides, serum Homocysteine, blood pressure and incidence of diabetes
Nguyen et al. 2014, 25(4)	California Health Interview Survey	CAM	CAM use may influence diabetes management behaviours
Salah Gariballa et al. 2013, 5	Randomized trial	Dietary supplementation	Need to do more clinical studies for better clinical outcomes
Ghulam Jilany Khan et al. 2014, 21(6)	A cross-sectional, interview-based survey	CAM	CAM can be used for disease management

CONCLUSION

This study focuses on complementary and alternative medicine, its significance, and utilization for minimizing diabetic complications. As per the data collected from various articles CAM therapy proved beneficial for the diabetic population by various mechanisms. CAM therapies include natural therapies like Yoga, mind-body intervention, energy therapy, reiki, tai chi, behavioural therapies, and utilization of natural medicines like herbs, vitamins, minerals, nutrients for disease management. CAM therapy shows its significance not only on disease outcomes but also improves the patient's physical, psychological, and social health. CAM utilization in type 2 diabetes was found to be associated with the reduction of plasma glucose levels, it also helps by maintaining HbA1c, improving insulin sensitivity, and again it can minimize comorbid states by maintaining biological markers and improves the health status of the patient.

This review concluded that CAM therapy found to have adept at reducing blood glucose, maintaining a healthy body, and relieving symptoms of DM. From the study, the relevance of CAM for managing Diabetic complications was verified and the future need to perform scientific researches on CAM use was analyzed.

Acknowledgement: Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

Conflict of interest: None

Source of funding: None

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