JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Restorative purpose of Yoga Asanas in Type 2 Diabetes

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Abstract: Since very long time, exercise is well thought-out as basis of diabetes management, in conjunction with diet and medicines. Mounting substantiation sustains the favourable upshots of yoga in corporeal and psychological wellbeing through down ruling of the Hypothalamic – Pituitary – Adrenal axis and the sympathetic nervous system (SNS). The rationale behind this paper is to endow with an intellectual reassessment of the literature of investigate studies comparing the effects of yoga and exercise in diabetes patients. This review focuses on published research articles indexed in the PubMed, MEDLINE, Google Scholar, Science Direct and Scopus. Search criteria included research articles written in English with the key words "yoga", "diabetes mellitus (DM)", "Type 1 DM", "Type 2 DM", "Exercise". Only clinical or human studies published in English language were included. Exclusion criteria included articles that were not written in English. Exercise can improve glucose uptake by improving insulin sensitivity and reducing body adiposity in both patients of type 1 and type 2 DM. Yoga is an ancient discipline designed to bring balance and health to the physical, mental, emotional, and spiritual dimensions of the individual. Yoga may be an attractive alternate to traditional aerobic exercises and strength training program, as it requires only a little space and needs no equipment and literally devoid of side effects, mainly focusing on relaxation of mind and body. It provides a less strenuous and more pleasurable exercise experience to an individual. Yoga can help the person feel better, both improving the physical fitness and elevating the mood. Numerous studies have shown positive benefits of yoga in the management of diabetes with good impact on glycemic control, lipid profile and cardiovascular status. Further it can alleviate stress. Yoga can be considered as a good alternate for exercise therapy.

Index Terms **- Yoga, Diabetes mellitus, Yoga asana; Pranayama, Meditation.**

INTRODUCTION

Insulin resistance with relative or absolute insulin shortage causes type 2 diabetes, which results in chronic hyperglycemia and a variety of cardiovascular problems. According to the International Diabetes Federation's diabetes atlas (seventh edition, 2017), there were around 425 million diabetics worldwide in 2017, with that number expected to rise to 629 million by 2045 [1]. The development of many lifestyle problems, including diabetes, is mostly influenced by sedentary habits and bad food patterns. Diabetes risk and severity are also increased by psychological stress. Lack of physical activity has been linked to a threefold increase in the risk of diabetes and a 2.4fold increase in the risk of coronary artery disease [2]. In individuals with type 2 diabetes and concomitant lifestyle problems such as obesity, hypertension, and dyslipidemia, dietary control and exercise are well-established therapy approaches.

People with diabetes are less likely to stick to dietary restriction and exercise as a management option as a result of urbanisation, calorie-rich food consumption, the use of various machines, a lack of open space for exercise, a hectic modern lifestyle, and a loss of desire. Furthermore, due to obesity, physical inactivity, a sedentary lifestyle, decreased joint mobility, and other diabetes-related comorbidities such as cardiovascular disease, peripheral neuropathy, and diabetic foot problems, people with diabetes have a diminished capacity to exercise. Poor adherence to diet and exercise programmes has been found in several studies to be a key stumbling block in the adoption of non-pharmacological diabetic therapy. Yoga, which originated over 5,000 years ago in India, strives to harmonize and balance the body, mind, and emotions [3].

Yoga practice appears to address the pathophysiologic mechanisms of diabetes and aids in the control of diabetes and its consequences, according to growing research. Based on information from several clinical trials, we briefly summarize the role of various yoga practices in the management of diabetes in this short overview.

II YOGA IN TYPE II DIABETES

Yoga as therapy is still a relatively new and rising concept in the healthcare profession, despite the fact that it has been practiced since ancient times. Yoga has been linked to changes in biochemical, electrophysiological, cellular, genetic, neuromuscular, and radiological para meters, according to extensive study. This has made it easier to apply yoga to a variety of ailments, and it is now

widely regarded as a clinically valid treatment. Yoga is a science of health management, not a therapy for treating specific ailments [4]. It is traditionally a mind-body practice with the ultimate objective of spiritual enlightenment.

III DIETARY MANAGEMENT OF DIABETES WITH YOGA

Yoga is also known to regulate eating patterns, and it has been suggested that yoga could be useful in the treatment of eating disorders. Yoga practice is thought to provide possibilities for self-awareness, introspection, and change because of the mind-body link [5]. Yoga, pranayama, and Sudarshan kriya have been shown to help with food habits and medication adherence.

IV YOGA PRACTICE AND MINDFUL EATING

Yoga practice has been linked to a higher consumption of fruits and vegetables, as well as improved eating habits and mindful eating [5]. Controlling binge-eating patterns may benefit from meditation and the ability to increase mindfulness. Mindful eating has been demonstrated to help people with diabetes increase their nutritional intake, lose weight, and control their blood sugar levels [6].

V RECOMMENDED PRACTICE BASED ON EVIDENCE IN DIABETES

Yoga is a multifaceted intervention that includes cleaning procedures (kriya), postures (asana), controlled breathing (pranayama), meditation, relaxation, chanting mantras, yogic food, code of behaviour, philosophy, and spirituality, among other things. Many yoga techniques have been found to be effective in the management of type 2 diabetes; nevertheless, their cautious use is recommended after a careful assessment of a patient's overall health, individual requirements, associated risk factors, and contraindications. Yoga activities of high or low intensity may be advised by assessing the person as whole, including physical inactivity and poor health behaviours [5]. The benefits of particular yoga postures or other practises are difficult to assess because most research have evaluated the impact of yoga activities such as postures, pranayama, relaxation, and meditation.

VI CLEANSING PROCESSES

Hatha Yoga Pradipika and Gheranda Samhita are two ancient scriptures that discuss purification/cleansing rituals called as shatkarmas. Vaman dhauti (stomach cleansing with induced vomiting), kapalbhati (frontal brain purification, a breathing technique with forceful exhalations and automatic inhalations), and shankhaprakshalana (intestinal cleansing) are three of these practises that help to increase insulin production and control blood glucose levels. Internal cleansing on a regular basis improves the organs' ability to function. A study found that practising vaman dhauti (emetic therapy) reduced fasting and postprandial blood sugar levels significantly [7-9]. Reduced amounts of circulating free fatty acids in the body are thought to boost glucose absorption, reduce insulin resistance, and promote insulin action. The abdominal pressure that is induced during the procedure for effectiveness of β-cells in the pancreas is improved by exhalation in kapalbhati. Shankhaprakshalana is a yoga practise that involves performing a series of yoga poses and sipping lukewarm water with salt in between. This process is repeated until only water is left. With this colon cleansing procedure, blood glucose levels drop dramatically. It is suggested that this practise boosts insulin production and aids in diabetes management [8]. Pulling the abdomen in (uddiyan bandha) and snapping it backwards and forwards while holding the breath is the Agnisar kriya (activation of the digestive fire). This action's 'vacuum' effect massages the internal organs while increasing blood flow to the area. It increases metabolism and aids in the healthy functioning of the body.

VII SURYA NAMASKAR (SUN SALUTATION)

Surya namaskar is a sequence of energetic yoga postures performed in a certain order. Surya namaskar performed quickly and energetically raises cellular oxygen and glucose requirements. Insulin production is stimulated by brain signalling to meet these requirements [8]. In a study of perimenopausal women, a yoga intervention consisting of 25 minutes of surya namaskar, various yoga postures, and a deep relaxation technique resulted in a substantial reduction in diastolic blood pressure and hip circumference, as well as good effects on glycaemic outcomes [10].

VIII ASANAS (YOGA POSTURES)

With an emphasis on breathing and movement synchronisation, asanas highlight the relationship between the body, mind, and awareness. There are stretches and twists to perform in addition to relaxation. It's important to execute a yoga pose in a sturdy and comfortable way. Seated poses such as yoga mudra, mandukasan, and Ardhamatsyendrasan promote pancreatic function. The pancreas is massaged and compressed by forward bends, which encourages the release of insulin. Colic secretions do not become stagnant when the intestines are squeezed and massaged in postures like vakrasan and ardhamatsyendrasan (seated spinal twist).

Depending on each person's capabilities, the therapeutic positions should be held for 30 to 1 minute; the length can then be gradually increased.

In a study, it was discovered that yoga poses helped persons with type 2 diabetes redistribute their fat and better use glucose [11]. Yoga poses that alternate between contractions and relaxations of the abdomen may help diabetics' pancreatic cells regenerate and become more sensitive. Improved blood flow to muscles can lead to increased insulin receptor expression in the muscles, which in turn can induce increased glucose uptake [2]. According to a study, doing ardhamatsayendrasana and dhanurasana produced the best results for controlling diabetes. Halasana, vajrasana, bhujangasana, and naukasana were also beneficial.

However, for reasons that are still unclear, participants' states of diabetes worsened in yoga mudra and shalabasana [12]. In one study, the effects of Dhanurasana + matsyendrasana, halasana + vajrasana, naukasana + bhujangasana, and setubandhasana + pavanamuktasana on pancreatic insulin release were examined [13]. It was found that the pancreatic cells were more sensitive to the glucose signal, which suggested that the asanas had a long-term impact. It has been suggested that doing yoga for just ten minutes in addition to standard medical care could significantly improve metabolic health [14].

IX PRANAYAMA (YOGIC BREATHING)

Pranayama is the name for the regulated or controlled breathing method used in yoga. Through the regulation of the autonomic nervous system, pranayama, or slow breathing, modifies the physiology of the entire body. Along with regularising breathing rate and pattern, it also normalises heart rate and its variability [15]. Examples of slow pranayamas that enhance cerebral blood flow and oxygenation include alternate nostril breathing (analogous breathing), left nostril breathing (chandranadi), cooling breaths (sitkari), and humming bee breathing (bhramari). This increases the outflow of sympathogastric fluid and the neuronal activity of the brain's centres, such as the medulla, hypothalamus, and limbic areas [15].

Research has shown that the practice of anulom vilom pranayama, or alternate nostril breathing, enhances three components of health-related fitness: percentage of body fat, cardiorespiratory endurance, and flexibility [16]. The humming bee breath, also known as bhramari prayanama, generates calming, pleasing vibrations that have the potential to be extremely advantageous for mental and physical health [17].

Because breathing through the right nostril is believed to have a sympathetic stimulating effect, diabetics may benefit from this advice [18]. The pranayama known as Bhastrika, or "the breath of fire," is a potent and invigorating practice. It supports the pituitary, adrenal, and pineal glands' regulation, all of which are essential for regulating metabolism [19].

X BANDHA (LOCK)

A bandha is a grip, a tightening, a locking. It redirects the flow of lymph and blood to other sections of the body while constricting a particular area. Bandhas can be used in conjunction with asanas or pranayama.

Abdominal lock, or uddiyan bandha, is a technique that involves compressing the abdominal area and applying negative pressure to the belly. It may be useful in the treatment of diabetes. It's thought that the abdominal cavity's negative pressure may enhance pancreatic function [20].

XI AUM/OM CHANTING

According to scientific studies, reciting "Aum" offers health benefits and is founded in the principles of sound, vibration, and resonance. Within minutes of practice, the brain stabilises, bad ideas are eliminated, energy levels rise, and the body relaxes as a result of chanting the "Aum" mantra [20]. Chanting "Aum" while in the supine position, known as prana vamsa, triggers an integrated relaxation response that may be useful in the treatment of diabetes and hypertension [21]. Assessment of the mind-sound resonance technique's immediate effects in individuals with type 2 diabetes revealed its potential for improving cognitive performance [22].

XII SUDARSHAN KRIYA

A particular breathing technique called sudarshan kriya combines chanting "Aum," ujjayi pranayama, and bhastrika pranayama with rhythmic, cyclical breathing at slow, medium, and rapid speeds. In a study, patients with diabetes who practiced sudarshan kriya yoga and pranayama showed significantly better overall quality of life as well as improvements in the physical, psychological, and social domains when compared to a group that received standard treatment alone [23].

XIII DHYAN (MEDITATION)

It has been demonstrated that meditation alters brain physiology. Beneficial psychological consequences of meditation include quicker responses to stimuli and a decreased susceptibility to stress in its different manifestations [24]. Patients with diabetes benefit from the mental stability that comes with meditation practice. Improvements in blood pressure control, anxiety reduction, and quality of life were observed after a 6-week meditation and sahaja yoga meditation treatment [25]. It is advised to visualise and focus on the pancreas during meditation since it has a beneficial impact on blood sugar regulation. People with diabetes and coronary heart disease are advised to practise mindfulness for improved sleep, increased relaxation, and more accepting attitudes towards illness and the illness experience [26].

XIV YOGIC RELAXATION TECHNIQUE, YOGA NIDRA (YOGIC SLEEP)

Conscious, dynamic, psychic sleep, or yoga nidra, is a deep, all-encompassing relaxation method that releases emotional, mental, and physical stress. When middle-aged diabetic patients on oral drugs practiced yoga nidra, their symptom scores improved and their fasting and postprandial blood glucose levels decreased [27].

XV MUDRAS (GESTURES)

Mudras are a series of delicate bodily gestures that can improve awareness and attention while changing mood, attitude, and perception [28]. Certain hand motions known as hasta mudras, like the linga, surya, and prana mudras, are thought to be beneficial for diabetes. Regular use of these mudras lowers blood sugar, increases metabolic rates, and aids in weight loss. Patients with diabetes can benefit from additional mudras including the apan and gyan mudras, which promote deep relaxation and stress relief.

However, no scientific research has assessed each of their effects separately.

XVI DURATION AND FREQUENCY OF YOGA PRACTICE

Studies have examined different frequencies and durations of yoga practice, but the suggested kind, length, and frequency of yoga practice have not been thoroughly established. Yoga sessions lasting anywhere from 10 minutes [14], 25 to 35 minutes [23], and 60

minutes every day [10], 45 to 60 minutes six days a week [29], three 75-minute sessions every week [30], and 90 minutes twice a week [9] have all demonstrated positive effects. Numerous studies have documented positive benefits after three months of the intervention [9, 10, 14, 29, 30, and a few others have assessed interventions that lasted fifteen days [31], forty days [32], and six months [23]. Yoga practice adherence has been demonstrated to affect the benefits of the practice [32].

XVII PRECAUTIONS AND CONTRAINDICATIONS

Yoga should be studied under the supervision of a certified yoga instructor. Yoga comes in a wide variety of forms, and while most of them are safe, some can be quite demanding and not suitable for everyone. Fast-paced yoga and intense workouts in high temperatures, such as hot yoga or Bikram yoga, are not advised for people with diabetes, cardiovascular disease, or those who are susceptible to problems. A reasonably safe yoga technique that fits each person's needs should be practiced. Extreme practices should be avoided by beginners. Individuals who take diabetes medication should closely evaluate how new exercise activities affect their bodies.

Ignoring pain and discomfort as warning signs during a yoga practice could lead to catastrophic harm. It is important for yoga practitioners to never exert themselves beyond their physical limits. Although it is usually advised to practise yoga on an empty stomach, diabetics may choose to have small snacks in order to avoid hypoglycemia. Sarvangasan and sheershasan are examples of inverted positions that cause blood to rush or pool into the head and upper body, thus increasing the risk of haemorrhage or retinal detachment. Patients with diabetes should avoid these poses, or practise them carefully and only after an ocular evaluation [33]. It's important to practise balancing poses carefully to prevent painful injuries. It is important to practise yoga positions carefully, without jerking movements or pushing yourself over your comfort zone.

Diabetes complications like autonomic neuropathy can lower blood pressure suddenly, which might make you feel lightheaded while sitting or standing up quickly. It is recommended that people with diabetes take their time entering and exiting poses, taking a few breaths to catch themselves as needed [34].

XVIII MECHANISM OF BENEFITS AND EVIDENCE FROM CLINICAL TRIALS

Yoga is founded on the idea that the mind and body are inextricably linked. Flexibility, muscle strength, blood circulation, and oxygen uptake are all improved [23]. Yoga has numerous health benefits, including increased physical fitness, relaxation, and self-awareness. Yoga can effectively treat a variety of lifestyle conditions, including diabetes, if high levels of adherence are maintained. Yoga practice enhances an individual's diet and exercise discipline, hence assisting in the modification of patient-related apprehension, which leads to the underutilization of exercise as a therapy tool [35]. Diabetes is a long-term metabolic disorder that has a negative impact on one's quality of life. Psychological stress and depression have a bidirectional effect on diabetes control [36].

By inducing the hypothalamic-pituitary-adrenal (HPA) and sympathetic axes as well as parasympathetic withdrawal, stress raises the risk and severity of diabetes by raising cortisol, epinephrine, norepinephrine, growth hormone, glucagon, catecholamines, prolactin, leptin, and neuropeptide Y levels [37]. Diabetes problems include diabetic neuropathy and inadequate management of the disease are linked to persistent activation of the HPA axis. Patients with type 2 diabetes experience insulin resistance as a result of elevated levels of inflammatory cytokines. Insulin resistance, hypertension, and an elevated risk of cardiovascular events can be brought on by prolonged psychological stress [38]. Because yoga successfully lowers stress, it helps regulate diabetes [39].

Healthy volunteers who practiced yoga reported feeling more balanced, having a new perspective on life, and experiencing improvements in their physical, psychological, and social well-being as well as a decrease in stress, anxiety, and sadness [25,39–41]. Psychological evaluations such as satisfaction impact and worry show considerable changes in scores for those who do yoga [42]. In addition to its effects on relaxation and stress management, yoga also improves physical exercise, food habits, and behavioural changes [35]. It is thought that abdominal flexibility during yoga activities causes pancreatic cells to regenerate [2].

Yoga poses serve to increase the sensitivity of β-cells to glucose, which in turn improves insulin secretion. They also boost blood flow to the muscles and promote muscle relaxation, which in turn improves glucose uptake. Glycaemic control in individuals with diabetes mellitus is also improved by improvements in hormonal homeostasis [43]. By enhancing immune system performance and lowering proinflammatory reactions, yoga treatment also has an immunomodulating effect [44].

The different health benefits of yoga therapy are linked to changes in hormone and neurotransmitter levels: β-endorphin, serotonin, and dopamine levels increase joy and euphoria during yoga therapy; arginine-vasopressin levels improve arousal and reduce GABA-ergic inhibition of the supraoptic area of the hypothalamus; melatonin provides a calming effect; lateral hypothalamic stimulation produces ecstatic and blissful feelings during yoga; and decreased GABA are linked to increased levels of N-acetylaspartylglutamate and 5-methoxydimethyl tryptamine (from pineal enzymes) during meditation [45].

The potential for causing stem cell trafficking from the bone marrow to the peripheral blood—which could result in tissue regeneration through the replacement and recruitment of cells differentiated from the stem cells—is what is meant to be implied by the term "beyond the drug action" associated with yoga practice [46]. But more research must be done on this mechanism. Additionally, yoga poses improve muscle function, strength, endurance, flexibility, and balance while also modulating gene expression. These benefits extend to body weight, adiposity, dyslipidemia, and insulin resistance [47]. Yoga lowers oxidative stress as evidenced by improvements in adiponectin levels and decreases in serum levels of leptin, interleukin 6, and malondialdehyde [44, 48]. Patients with diabetes who receive yoga therapy had higher proportions of insulin receptor binding and more insulin receptors overall [49]. By lowering fasting insulin levels, moving the peak insulin level to the left, and bringing the insulin-to-

glucose ratio back to normal, it enhances insulin kinetics [50]. Additionally, it lowers free fatty acid levels, which may suggest increased insulin sensitivity or decreased insulin resistance [51].

Lung function tests were reported to improve with yoga and other breathing techniques [52]. People with type 2 diabetes who practice yoga show improvements in the lymphocyte migration test, indicating an improvement in cell-mediated immunity [53]. In high-risk patients, yoga also averts the development of diabetes [54]. It was discovered to help diabetics' symptom scores [55]. Additionally, it lowers the need for anti-diabetic medications, postprandial blood sugar, haemoglobin A1c, and fasting blood sugar, all of which point to better glycemic control. Lean body weight increases as a result of yoga therapy's effects on body weight, body mass index, waist-to-hip ratio, body fat mass, and body fat percentage reduction. Yoga raises levels of HDL cholesterol while lowering triglyceride, free fatty acid, and low-density lipoprotein cholesterol [56]. It fosters self-control over diet and activity [6].

Regular yoga practice increases one's tolerance to exercise; on the treadmill test, it has been demonstrated that yoga increased performance from eight metabolic equivalents (METS) to twelve METS and delayed the anaerobic threshold [57]. According to certain research, people who practice yoga had lower systolic and diastolic blood pressure [58]. Regular yoga practice lowers the risk of complications from diabetes. Patients with diabetes mellitus may experience sudden mortality due to cardiac autonomic dysfunction.

According to clinical research, practicing yoga on a regular basis lowers the incidence of cardiovascular events and enhances cardiac autonomic function without affecting glucose regulation [59]. Additionally, yoga therapy stabilizes the coagulation profile, which helps diabetic patients' nerve conduction and cognitive performance [60]. Weight gain occurs in patients with type 2 diabetes when glycaemic control is improved without diet or exercise, such as when insulin dosage is increased or anti-diabetic medications are taken. On the other hand, research suggests that yoga lowers body weight and enhances glycaemic management without increasing it [14]. Because of yoga's simplicity, safety, and numerous psychological advantages, it is becoming more widely recognized in society and is now seen as an inexpensive remedy to manage problems, including diabetes [35].

XIX LIMITATIONS OF STUDIES ON YOGA

Clinical investigations investigating the impact of yoga on health and various disorders have numerous flaws. Clinical investigations that looked into the therapeutic potential of yoga in treating diabetes were limited by a lack of suitable control groups, small numbers of patients, and short study durations. Furthermore, several of the research just looked at blood sugar levels as an endpoint, ignoring all of yoga's other potential advantages. Selection bias, confounding factors' influence, a lack of adequate research methods, inconsistency of baseline data, and a lack of appropriate statistical analysis all make it difficult to interpret yoga studies [61]. We can improve yoga research studies by improving study methodology, reducing bias, studying long-term adherence to yoga practise (including home practise) to assess the long-term benefits of yoga, and examining specific components of yoga therapy to gain a better understanding of specific types of yoga and their benefits.

XX CONCLUSION

Yoga treatment is beneficial for both health and illness. The most recent scientific evidence suggests that yoga-based lifestyle changes may have a role in the management of type 2 diabetes and its risk factors. Psychoneuroendocrine and immunological systems are thought to have a comprehensive effect on diabetes control. Patients' entire metabolic and psychological profiles improve as a result of parasympathetic activation and the related anti-stress processes, which also improve insulin sensitivity, glucose tolerance, and lipid metabolism. Yoga activities such as cleaning, asanas, pranayama, mudras, bandha, meditation, mindfulness, and relaxation have been shown to lower blood glucose levels and aid in the treatment of concomitant medical conditions associated with type 2 diabetes, with considerable good clinical outcomes.

ACKNOWLEDGEMENTS

Authors also express special and heartfelt thankfulness to Columbia Institute of Pharmacy, Raipur for providing a platform for enhancing the study skills.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article.

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