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Review Article

Yoga For Metabolic Syndrome

Yoga For Metabolic Syndrome: A Comprehensive Review.

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Abstract: With increased urbanization and industrialization, there is an emerging global epidemic of obesity which is a forerunner of metabolic syndrome. The most significant underlying cause of the metabolic syndrome is insulin resistance and its consequences. The metabolic syndrome causes lipogenesis and fat deposition. It is one of the most important risk factors for the development of catastrophic health consequences such as coronary artery disease, myocardial infarction, diabetes mellitus Type II, fatty liver, and malignant diseases. While most of these patients are treated by pharmacotherapy, there is a growing interest in studying the effectiveness of alternative therapies, including Yoga. Yoga has been practiced in India for thousands of years. Yoga, particularly Asana and Pranayama, is effective not only in improving the overall health and well-being of an individual but also reported to be effective in managing chronic medical conditions such as hypertension, diabetes, and autoimmune disorders. Various studies have found Yoga to be not only preventive but also of therapeutic value. Yoga not only has physical elements but also consists of breathing techniques, mindfulness, meditation, and relaxation techniques; hence it not only strengthens the body (secondary to physical exercise) but also positively impacts the psychosocial well-being of individuals practicing Yoga regularly. We undertook this review to determine the effectiveness of Yoga in patients with metabolic syndrome and to know whether Yoga has therapeutic benefits in patients with metabolic syndrome. Moreover, an attempt was also made to determine whether there was a significant reduction in the risk of secondary cardiovascular complications in these patients.

Keywords: Yoga, Metabolic Syndrome, Syndrome X, Dyslipidemia, Hypertension, Obesity, Yoga Therapy

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1. INTRODUCTION

The underlying cause of metabolic syndrome (MetS) is insulin resistance and its consequences. It primarily causes lipogenesis and fat deposition[1]. It is one of the most important risk factors for the development of coronary artery disease, myocardial infarction, diabetes, fatty liver, and malignant diseases. In males, obesity is associated with an increased risk of colorectal cancer. In females, obesity and metabolic syndrome are reported to be associated with an increased risk of breast, endometrial, and ovarian malignancies[2]. This increased risk is reported to be secondary to increased estrogen levels secreted by adipose tissue. The major constituents of MetS are hypertriglyceridemia, hyperglycemia, reduced high-density lipoprotein cholesterol, abdominal obesity, and cardiovascular manifestations[3]. The other features in individuals with MetS include acanthosis nigricans, peripheral neuropathy, hirsutism, and retinopathy. Some other manifestations, such as xanthelasmas, may be secondary to severe hyperlipidemia[4]. For the definitive diagnosis of MetS, at least 3 of the following five features must be present[5].

1. Fasting glucose ≥100 mg/dL
2. Blood pressure ≥130/85 mm Hg.
3. Triglycerides ≥150 mg/dL.
4. HDL-C < 40 mg/dL in men or < 50 mg/dL in women
5. Waist circumference ≥102 cm (40 in) in men or ≥88 cm (35 in) in women.

Stress has been defined as a 'nonspecific response of the body to any noxious stimulus,' and the stress response is associated with heightened sympathetic nervous activity and increased energy expenditure along with associated changes in heart rate, breath rate, and blood pressure. Stress places a metabolic burden on homeostatic processes. If stress is severe or prolonged, it may lead to disturbed homeostasis, distress, and psycho-physiological dysfunction with increased resting metabolic rate exacerbation of metabolic dysfunction and acceleration of aging morbidity and mortality. Several longitudinal studies further suggest that severe prolonged stress is associated with the development of MetS, which is related to impaired mitochondrial functioning and metabolic inflexibility.[6] Management of MetS is multidimensional, and no single intervention can be solely practical. It may include drug therapy such as statins for hypertriglyceridemia, hypoglycemic drugs for hyperglycemia, niacin, and omega-3 fatty acids. Lifestyle modifications and regular exercise may reverse a mild degree of metabolic syndrome. Alternative therapy, such as Yoga therapy, has also been reported to be effective in arresting or reversing MetS.[7] Yoga is an ancient Indian practice comprising a form of physical activity incorporating psychological components. It is reported to be practiced in India since ancient times. Yoga not only does have physical elements but also consists of breathing techniques, mindfulness, meditation, and relaxation techniques; hence it not only does strengthen the body (secondary to physical exercise) but also has a positive impact on the psychosocial well-being of the individual practicing Yoga regularly.[8] Yoga as a therapy is becoming widespread worldwide, and its applications are increasing in different clinical conditions.[9] Many trials have concluded that Yoga not only has a positive impact on the overall health and well-being of an individual but is also specifically effective in maintaining blood glucose levels, controlling blood pressure, and preventing obesity and its consequences such as metabolic syndrome, coronary artery disease, and myocardial infarction.[10], many randomized controlled trials are studying the impact of Yoga on various disorders, including but not limited to autism, diabetes, hypertension, cardiovascular diseases, anxiety, attention deficit hyperactive disorders, learning disabilities, and metabolic syndrome.[11]

1.1 Metabolic Syndrome

Metabolic Syndrome is a group of risk factors that increase the likelihood of developing cardiovascular disease and type 2 diabetes. These risk factors include abdominal obesity, high blood pressure, high blood sugar, high triglycerides, and low HDL cholesterol. Yoga is a form of exercise that can help manage the symptoms of metabolic syndrome by improving cardiovascular fitness, reducing stress, and promoting weight loss. Studies have shown that regular Yoga can lower blood pressure, improve insulin sensitivity, and decrease abdominal fat, which can help reduce the risk of developing metabolic syndrome and related health conditions. Additionally, Yoga's stress-reducing effects can help improve mood and overall well-being. We conducted this systematic review of literature in which various studies analyzing the effect of Yoga therapy on MetS were studied. It is a unique review in which we tried to find out the outcome of various studies regarding the effect of Yoga on MetS in individuals. Moreover, an attempt was also made to determine whether there was a significant reduction in the risk of secondary cardiovascular complications in these patients.

1.2 Review

Yoga has been practiced in India for thousands of years. With increasing awareness about the adverse effects of modern medicine, there has been a tremendous increase in interest in traditional and alternative medicine, which is likely devoid of at least serious complications. Yoga, particularly Asana and Pranayama, is effective not only in improving the overall health and well-being of an individual but also reported to be effective in managing chronic medical conditions such as hypertension, diabetes, and autoimmune disorders.[12]

1.3 *Yoga and Metabolic Syndrome*:

Yoga consists of 3 essential components: physical exercise, breathing techniques, and relaxation techniques. Using these three essential components of Yoga, many diseases are not only prevented but can also be controlled. However, it is not only an extremely economical, affordable, and readily available method of combating various ailments but also devoid of any side effects, which is the most important consideration when treating patients with chronic systemic illnesses such as diabetes and hypertension. The benefits of Yoga in patients with systemic illnesses such as hypertension and diabetes are based on determinants such as glycemic control, frequency of medications, progression to complications, and quality of life of the patients suffering from these diseases.[16] Yoga therapy is

a holistic approach that can be used to help manage the symptoms of metabolic syndrome. This condition, characterized by a cluster of risk factors, including high blood pressure, high blood sugar, and excess body fat around the waist, is a leading cause of heart disease and diabetes. Yoga therapy can help improve cardiovascular health by reducing stress, promoting relaxation, and helping lower blood pressure and blood sugar levels. Additionally, yoga postures and breathing exercises can help promote weight loss and improve muscle tone, which can help reduce the risk of metabolic syndrome. Regular yoga practice can also improve overall well-being and mental clarity and increase the ability to cope with stress. It is essential to consult a doctor before starting a new exercise program, especially if you have any underlying health conditions. The role of Yoga in managing individuals with MetS has been a topic of immense research among researchers. Innes et al. conducted a systematic review of published literature regarding the effects of Yoga, a promising mind-body therapy, on specific anthropometric and physiologic indices of cardiovascular disease (CVD) risk and related clinical endpoints. The authors found a significant improvement in MetS-related indices of CVD risk, including glucose tolerance and insulin sensitivity, lipid profiles, anthropometric characteristics, blood pressure, oxidative stress, coagulation profiles, sympathetic activation, and cardiovagal function, as well as improvement in several clinical endpoints. Based on these findings, the authors suggested that Yoga may reduce many IRS-related risk factors for CVD, improve clinical outcomes, and aid in managing CVD and other IRS-related conditions.[17] Bhavanani et al. concluded that the holistic science of Yoga is the best lifestyle ever designed to manage lifestyle disorders like diabetes effectively. They found that modern research has focused on psycho- physiological beneficial effects of Yoga as it is more than a physical exercise.[18] Metabolic syndrome is the forerunner of diabetes and hypertension. If the proper intervention is done in these cases, then there are all chances that the individuals with MetS will progress to diabetes. Yoga can delay the onset of diabetes in these individuals. Moreover, it has also been found to be of therapeutic value in cases with diabetes. Jyotsana et al. conducted a study to assess the effect of a comprehensive yogic breathing program on glycemic control and quality of life (QOL) in patients with diabetes. In this study, patients having HbA_1c between 6 and 9% for at least three months with lifestyle modification and oral antidiabetic medication were included. They were followed up and randomized at six months into two groups: one group receiving standard treatment of diabetes and the other group receiving standard treatment of diabetes and taught and told to regularly practice the comprehensive yogic breathing program (Sudarshan Kriya Yoga and Pranayama). Changes in fasting and post-prandial blood sugars, glycated hemoglobin, and QOL were assessed by the World Health Organization QOL WHOQOL BREF questionnaire. The study found a trend toward improvement in glycemic control in the group practicing the comprehensive yogic breathing program compared with the group following standard treatment alone. Based on these findings, the authors concluded that there was an improvement in the QOL and a non-significant trend toward improvement in glycemic control in the group practicing the comprehensive yogic breathing program compared with the group that was following standard treatment alone.[19] Madanmohan et al. studied the effect of Yoga therapy on reaction time, biochemical parameters, and wellness score of peri and post-menopausal diabetic patients. They found that Yoga improved the 'heart friendly' status of lipid profile and significantly decreased cardiovascular risk profile. They concluded that a comprehensive Yoga therapy program has the potential to enhance the beneficial effects of standard medical management of diabetes mellitus and can be used as an effective complementary or integrative therapy program.[20] Similarly, Amita et al. conducted a study to evaluate the effect of Yoga-Nidra on blood glucose levels in diabetic patients. This study was conducted on 41 middle-aged, type-2 diabetic patients who were oral hypoglycemic. Yoga-Nidra was practiced for 30 minutes daily for up to 90 days. Parameters were recorded every 30th day. Results of this study showed that most of the symptoms subsided, and the fall in mean blood glucose level was significant after three months of Yoga-Nidra. Results of this study suggest that subjects on Yoga-Nidra with a drug regimen had better control of their fluctuating blood glucose and symptoms associated with diabetes than those on oral hypoglycemics alone.[21] Not only does Yoga improve glycemic control, but it is also found to stabilize autonomic functions. Singh et al. conducted a study in which twenty-four Type 2 DM cases were included. These middle-aged subjects were type II diabetics on antihyperglycemic and dietary regimens. Their baseline fasting and post-prandial blood glucose and glycosylated Hb were monitored along with autonomic function studies. The expert gave these patients training in yoga asanas, and they pursued those 30-40 min/day for 40 days under guidance. These asanas consisted of 13 well-known postures done in a sequence. After 40 days of the yoga asanas regimen, the parameters were repeated. The study found a significant decrease in fasting blood glucose levels from basal 190.08 +/- 18.54 in mg/dl to 141.5 +/- 16.3 in mg/dl after the yoga regimen. Moreover, these patients' pulse rates and systolic and diastolic blood pressure decreased significantly. Based on these findings, the authors concluded that better glycemic control and stable autonomic functions could be obtained in Type 2 DM cases with yoga asanas and pranayama.[22] Kelly et al. studied Yoga intervention for type 2 diabetes risk reduction: subjects assessed with BMI, waist circumference, FBS, PPBS, insulin, insulin resistance, BP, and lipid levels. They reported that Yoga offers a promising lifestyle intervention for decreasing weight-related type 2 diabetes risk factors and potentially increasing psychological well-being.[23] Netam et al. conducted a study of 34 overweight/obese [body mass index (BMI) ≥ 23 to <35 kg/m [2] per Asian cut-off values]. All patients received directly supervised intervention for ten days. Afterward, they were advised to follow this yoga-based lifestyle at home for one month and reassessed for study variables on day 30. The authors found a reduction from baseline to day 10 in weight, waist/hip ratio, blood glucose, and a significant improvement in lipid profile. There was a decrease in median fasting insulin, homeostatic model assessment-insulin resistance, and IL-6. A non-significant increase in 25-OH-vitamin D and a decrease in neopterin and vaspin were observed. Twenty subjects returned for follow-up assessments. On day 30, weight loss was sustained, while systolic blood pressure was also reduced. Changes in vitamin D levels were significantly and negatively correlated with changes in weight, BMI, and fasting blood

glucose and positively with changes in high-density lipoprotein. Changes in body weight and BMI significantly and positively correlated with insulin. Changes in IL-6 levels positively and significantly correlated with changes in neopterin levels. Based on these findings, the authors concluded that a short-term yoga-based lifestyle intervention favorably modified IL-6, vitamin D, and diabetes risk factors in obesity.[24] Finally, a study by Kanaya et al. tested a restorative yoga intervention with active stretching for metabolic outcomes. For this purpose, the authors conducted a 48-week randomized trial comparing restorative Yoga and stretching among underactive adults with metabolic syndrome at the Universities of California, San Francisco, and San Diego. The authors provided lifestyle counseling and a tapering series of 90-min group classes in the 24-week intervention period and 24-week maintenance period. Fasting and 2-h glucose, HbA_1c, triglycerides, HDL-cholesterol, insulin, systolic blood pressure, visceral fat, and quality of life were assessed at baseline, 6- and 12 months. At six months, favorable changes within the yoga group included reductions in fasting glucose, insulin, and HbA_1c and an increase in HDL-cholesterol that were not sustained at one year except for changes in fasting glucose. The stretching group had a significant reduction in triglycerides at six months which was not sustained at one year but had improved quality of life at both time points. Based on these findings, the authors concluded that Yoga was better than stretching for improving fasting glucose levels, whereas such benefit was not found for metabolic factors.[25] Balaji et al. I concluded that regular yoga therapy, applied as an adjuvant to medical management, may retard the progression of kidney damage in diabetic patients.[26] They also found that the addition of Yoga as an adjuvant therapy to standard medical care can provide additional benefits in terms of improving a physical condition and pulmonary function. [27] A pilot study on metabolic syndrome and yoga therapy done at tertiary care hospitals found that adjuvant yoga therapy is beneficial in maintaining good health and reducing metabolic risk factors[28].An extensive search on Cochrane and PubMed websites showed that Yoga helps delay the onset of diabetes mellitus type II in patients with insulin resistance.Moreover, it also helps in improving dyslipidemia and blood pressure control. It retards the progression of metabolic syndrome to full-blown diabetes mellitus[29,30] It also has been found to help reduce weight in individuals with morbid obesity.[31]Moreover, Yoga is also found to have a positive impact on the psychological health of geriatric patients[32]and elderly women living in hospice[33]. Gowri et al. concluded that yogic interventions help to attenuate oxidative stress and benefit the cells of pancreas rejuvenation directly[34].

Table 1 Shows the number of studies (mostly from indexed journals) on Yoga with components of metabolic syndrome

S.no	Outcome measures	No of studies	outcomes
1	Insulin resistance	44	Significant reduction in blood sugar levels by enhancing insulin sensitivity
2	Hypertension	43	Improvement in baroreflex sensitivity, systolic BP, and total peripheral vascular resistance in hypertensive patients
3	Dyslipidemia	28	Decreased Serum total cholesterol, serum triglycerides, serum LDL levels, and a significant increase in HDL.
4	Obesity	29	safe and effective intervention to reduce body mass index in overweight or obese individuals.
5	Metabolic Syndrome	18	promising evidence of Yoga on improving cardio-metabolic health
6	Psychological problems in old patients and those living in hospice	11	Improves psychological well-being in geriatric patients and individuals living in hospice

Yoga has been shown to improve insulin sensitivity, lower blood pressure, and aid in weight management, making it a beneficial practice for individuals with insulin resistance, hypertension, and obesity. Regular yoga practice can also help to reduce stress and improve overall health.

2. Summary

MetS is one of the most important risk factors for developing systemic illnesses such as hypertension and diabetes. While pharmacological management is essential for these illnesses, there is a risk of developing resistance to treatment and incidence of various side effects of these drugs. Because of these reasons, there is increased interest amongst researchers to study the effectiveness of alternative therapies such as Yoga and alternative medicine. Yoga is found to be effective in preventing MetS in patients prone to develop it and may reverse it in patients in whom it has already occurred. Even in patients with metabolic syndrome that has progressed to systemic illnesses such as type II diabetes and hypertension, Yoga may be helpful as adjuvant therapy in addition to antihypertensives and antidiabetic drugs. Various studies have found a positive effect of Yoga on blood glucose levels, Blood pressure, autonomic system, and lipid profile.

3. CONCLUSION

The global epidemic of obesity, which is a leading cause of metabolic syndrome has increased interest in studying the effectiveness of alternative therapies, such as Yoga, in managing chronic medical conditions. Yoga, particularly Asana and Pranayama, is effective in improving overall health and well-being, as well as managing conditions such as hypertension, diabetes, and

autoimmune disorders. Studies have shown that Yoga can be both preventive and therapeutic, with physical elements, breathing techniques, mindfulness, meditation, and relaxation techniques that not only strengthen the body but also positively impact the psychosocial well-being of individuals practicing Yoga regularly. This review aimed to investigate the effectiveness of Yoga in patients with metabolic syndrome and to determine whether Yoga can reduce the risk of secondary cardiovascular complications in these patients. Yoga is found to have a beneficial effect in patients with MetS and found to have preventive as well as therapeutic benefits. In patients with MetS, diabetes, and hypertension, Yoga has an effective role in addition to pharmacotherapy.

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5. AUTHOR CONTRIBUTION STATEMENT

R. Balaji created the concept. Manuscript preparation and supervision by Ananda Balayogi Bhavanani Data and literature research by Lakshmi. Manuscript preparation and communication by Jatiya Meena Ramanathan

6. CONFLICT OF INTEREST

Conflict of interest declared none.

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