ORIGINAL ARTICLE

Role of yoga as an adjuvant therapy in the management of metabolic syndrome – A randomized control pilot study

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ABSTRACT

Introduction: Metabolic syndrome (MetS) is a public health threat rising globally at an alarming rate. Yoga as a therapy is becoming increasingly popular and its applications are increasing in various clinical conditions. Yoga is an integrated system of self-culturing, aimed at coordinated development of body and mind leading to enhanced physical health, spiritual harmony, positive thinking, happiness and peace.

Aim: This study aimed to study the role of yoga as adjuvant therapy in the clinical management of MetS.

Methods: The study was done an interdisciplinary collaborative work between Center for Yoga Therapy and Department of General Medicine of MGMCRI, Sri Balaji Vidyapeeth, Puducherry. Thirty newly diagnosed MetS patients were recruited; prestudy evaluations of body mass index, waist circumference, hip circumference, pulse rate, systolic blood pressure (SP), diastolic blood pressure (DP), fasting blood sugar, postprandial blood sugar, glycosylated hemoglobin, and fasting lipid profile were done. By the method of simple randomization, subjects were allocated to yoga therapy group (n = 15), who received yoga therapy thrice weekly for 3 months along with standard medical management and to control group (n = 15) who received only standard medical management. Poststudy evaluation of all parameters was done at the end of the study period. Data were analyzed by Student's paired 't' test, as all data passed normality.

Results: There was a statistically significant ($p < 0.05$) reduction in all the above parameters in yoga group compared to control group. Changes seen in control group were missing significance.

Conclusions: It may be concluded from the present pilot study that adjuvant yoga therapy is beneficial in maintaining good health and reducing metabolic risk factors. This may have impact on utilization of yoga therapy as a secure and cost-effective add-on therapeutic modality in combating MetS.

Key Words: Abdominal obesity, dyslipidemia, hyperglycemia, hypertension, insulin resistance, syndrome X, yoga therapy

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INTRODUCTION

The metabolic syndrome (MetS) is now considered a serious public health problem, rising at an alarming rate in developed and developing countries of the world. It is estimated that 20%–25% of the world adult population is suffering from this disorder (Tapas & Sutapa, 2015). Yoga is a time-tested traditional method of self-healing that is becoming popular around the world due to its multiple benefits. It can be considered an integrated system of self-culturing, aimed at the coordinated development of body and mind, covering all aspects of human life. It thus enhances physical health, mental peace, and spiritual harmony. Yoga envisages health in totality through the principle of healthy mind in a healthy body (Manchanda, 2014; Herrick & Ainswort, 2000). MetS causes lipogenesis and fat deposition. It is one of the most important risk factors for development of catastrophic health consequences such as coronary artery disease, myocardial infarction, type II diabetes mellitus, and fatty liver and malignant diseases. MetS is a deranged condition of energy utilization and storage in the body, which leads to the development of several related medical conditions, such as elevated fasting blood sugar (FBS), central obesity, high serum cholesterol (triglyceride), and low high-density cholesterol level (HDL) and elevated blood pressure (Alberti, Zimmet & Shaw, 2006). In this modern world, each and every day, the number of people who are diagnosed with MetS is increasing, especially in India which is being considered as the capital of diabetes. In 2013, about 12% of the world's adult population (2.85 core people) had diabetes and 3.16 cores had impaired glucose tolerance (Nidhi, 2015). Women are at a greater risk as do certain ethnic groups, such as South Asians, Pacific Islanders, Latinos, and Native Americans. The curve is going on rising among Indians and is expected to reach 7.9 cores by 2030, which will be higher than even China. Hypertension is the major risk factor for many noncommunicable diseases such as cardiovascular diseases, stroke, renal failure, and diabetes mellitus (Ibekwe, 2015, Williams, 2001; Powers, 2001). Aside from developed countries with aging populations, developing countries such as India with younger populations are showing increasing trends in the prevalence of hypertension which is estimated to cause 4.5% of current global diseases and about one billion people suffer from its worldwide (Whitworth & World Health Organization, International Society of Hypertension Writing Group, 2003; Ferro, Gilbert & Krum, 2006). Yoga as a therapy is becoming increasingly popular around the world and its uses are increasing in various clinical conditions. Yoga has shown positive results in the physical, mental, and emotional aspects in those suffering from obesity, cardiovascular disorders including hypertension as well as diabetes. Today, yoga is popular all over the world and is being practised as a healthy lifestyle, and lifestyle modifications are to be seriously considered as an adjunct to drug interventions (Wang & Vasan, 2005). Yoga influences the body as well as controls the stress (external or internal) in the individual, promotes well-being, improves quality of life, and its safety profile is excellent. This present study has been undertaken to analyze the role of yoga as an adjuvant therapy on MetS on the physical, physiological, and biological parameters among healthy volunteers.

METHODS

The randomized control trial of 3 months (June 2019 to August 2019) was undertaken as an interdisciplinary collaborative work between Center for Yoga Therapy, Education, and Research (CYTER) and Department of General Medicine of Mahatma Gandhi Medical College and Research Institute, Sri Balaji Vidyapeeth, Puducherry. Requisite approval was obtained from Institutional Research council and Human Ethics Committee, Sri Balaji Vidyapeeth. (2018\06\02). After obtaining informed consent, newly diagnosed MetS patients who were willing to participate in the yoga therapy program and able to perform the techniques in the protocol were recruited for the study. Patients having complications caused by MetS, patients receiving AYUSH therapies, and those with abnormal Glomerular Filtration Rate (GFR) values (less than 60 ml/min) were excluded from the study. Simple random sampling method was followed, and thirty newly diagnosed MetS patients (18 females and 12 males) who attended OPD of General Medicine of MGMCRI were screened and assessed for eligibility by medical officer of general medicine department as per the inclusion criteria. Recruited subjects were then randomized to yoga group (n = 15, mean age: 45 ± 8.65 years), who received yoga therapy for 1 h thrice weekly and were motivated to do home practice and maintain a diary to evaluate compliance for 3 months along with standard medical management, whereas participants in control group (n = 15, aged 44.93 ± 9.04 years) received only standard medical management. Standard medical management includes oral hypoglycemic drugs such as sulfonylureas/biguanides/glitazones or insulin for glycemic control, anti- hypertensive drugs include ACE inhibitors/ calcium channel blockers/diuretics for blood pressure, and statins were used for dyslipidemia. All the subjects received dietary advice along with medical management.

Yoga therapy sessions were conducted at CYTER by trained and qualified yoga therapists. Components of yoga therapy protocol with the duration are given in Table 1.

Anthropometric data

Data were taken for all the subjects in the Patanjali Yoga hall of CYTER. Individual height was measured to the nearest mm by the wall-mounted stadiometer and weight was measured with a weighing scale (Krups scale). Body mass index (BMI) was calculated by Quetelet's index, (weight [kg]/height $[m]^2$) – body weight was measured using pedestal type scale having an accuracy of 10gm. WC (in cm) was measured at the level of the umbilicus in the erect position. The hip circumferences (HCs) were measured 4 cm below the anterior superior iliac spine. To ensure objectivity in measuring HR and BP, the recordings were done using noninvasive automatic BP monitor (Omron Healthcare Manufacturing Vietnam Co., Ltd.) with an instrumental accuracy of ± 5% for HR and ± 3 mm Hg for BP. Blood sample was collected to measure the biochemical parameters (FBS, fasting insulin, glycosylated hemoglobin [HbA_1c], lipid profile, blood urea, and serum creatinine), the blood sample was properly stored using a standard mechanism and was analyzed within 4

Table 1: Yoga therapy techniques (administered thrice a week for 3 months) and their duration

Yoga practices	Duration (min)
Jattis (warming up practices)	8
Tala Asana and Kriya (stretching up like a palm tree performed by synchronized breathing movements)	3
Veera Asana I and II warrior pose to bring the stability and to develop courage psychologically	3
Pawanamukta Asana and Kriya (to create pressure and tone abdominal area, especially in lower abdomen and to stimulate Jatharagni)	5
Chatushpadaasana and Vyagraha (dynamic four-foot posture and with rhythmic spine movement with synchronized breathing)	5
Pranava pranayama (using universal Prana vibhaga has foundation chanting Akara, Ukara, Makara, and Omkara Nada)	8
Sadantha/Kavi pranayama (cooling Pranayama inhaling through the gaps in teeth and exhaling through nose)	5
Brahma mudra (movements of the head to four directions: namely right, left, up, and down with the breathing and usage of Akara, Ukara, Ekara, and Makara nada, respectively)	5
Anyone of the following in each class	
i) Kaya kriya (movement of feet, hands, and head during inhalation and exhalation)	8
ii) Maranasthanam (part by part relaxation by conscious focus on each part)	
Shavasana	10
Total duration	60

hours of specimen collection. After obtaining the consent, 3 ml of fasting blood were collected for the preparation of the serum. An additional 3 ml was collected into ethylenediaminetetraacetic acid vacationers for plasma preparation. All the biochemical parameters were estimated using the International Federation of Clinical Chemistry-approved methods (Sciacovelli et al., 2019). Blood urea was measured by glutamate dehydrogenase method, and serum creatinine was estimated by Jaffe kinetic method in Hitachi 902 autoanalyzer at the Central Laboratory of MGMCRI (Preeti & Suresh, 2017; Barsotti, 2001; Häberle, 2011). The collection and analysis of all blood samples was carried out by qualified technicians of the Central Laboratory of MGMCRI, and they had no knowledge of the subjects and their allocation to the respective groups.

Statistical analysis

Statistical analysis was done using SPSS, version 20.0 statistical software.(IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Data were analyzed using paired and unpaired "*t*"-test and descriptive statistical method. The intragroup comparisons of pre and poststudy data were done using Student's paired test, while intergroup comparisons between groups were done using Student's unpaired "*t*" test. The results were considered statistically significant and *p* values were found to be <0.05 in a confidence interval of 95%.

RESULTS

The results are given in Table 2. The baseline values in both groups were comparable, while intragroup comparisons showed a significant decrease ($p < 0.001$) in all parameters in patients receiving adjuvant yoga therapy. In control group, a reduction was seen in most parameters, yet they did not reach a level of statistical significance. Intergroup comparisons revealed significant differences between groups with regard to all the parameters.

DISCUSSION

This study was planned to assess the impact of yoga as an adjuvant therapy and lifestyle intervention in MetS patients for the derangement of anthropometric indices (height, weight, BMI, WC, and HC), cardiovascular parameters (pulse rate, systolic blood pressure [SP], and diastolic blood pressure [DP]) glycemic profile (FBS, postprandial blood sugar, and HbA_1c), fasting lipid profile (TC, triglycerides, HDL, low-density lipoprotein, and very-low-density lipoprotein), renal profile blood urea, and serum creatinine.

Effect of yoga therapy on anthropometric measures

In the present study, weight and BMI showed a significant decrease in yoga group, and though they also decreased in control group, it was not statistically significant. comparison shows the difference between the pre- and postvalues in the yoga group and control group for weight, BMI, waist, and HC that yielded statistically significant difference. This may due to the practice of yogic techniques which helps utilize the excess fat deposited peripherally and around the waist and helps to tone up the musculoskeletal system positively by improving the metabolic activity. Similar findings were reported in few other previous studies (Artchoudane, Ranganadin, Bhavanani, Ramanathan & Madanmohan., 2018; Balaji, Ramanathan, Bhavanani, Ranganadin & Balachandran, 2019; Madanmohan, Bhavanani, Dayanidy, Sanjay & Basavaraddi, 2012; Walker, Meekins & Hu, 2005; Divekar, Bhat & Mulla, 1978; Jain, Uppal, Bhatnagar & Talukdar, 1993).

Effect of yoga therapy on cardiovascular parameters

Significant reduction in cardiovascular parameters was found following adjuvant yoga therapy, implying that yogic practices increase parasympathetic dominance and thereby promotes better autonomic regulation by which it reduces the pre- and postload on the functioning of the heart (Bhavanani, Ramanathan & Madanmohan, 2008) Changes in cardiac output, peripheral vascular resistance, and humoral factors may be the possible

Table 2: Comparison of anthropometry, cardiovascular, diabetic, fasting lipid profile and renal profile and in yoga and control groups after 3 months of study period

Parameters	Yoga ($n=15$)			Control ($n=15$)			*P* between groups
	Pretest	Posttest	*P*	Pretest	Posttest	*P*	
Height (cm)	161.28±8.31	161.18±8.32	0.9113	161.16±8.52	161.58±9.90	0.9219	0.54
Weight (kg)	80.93±8.95	77.73±8.69	<0.001	80.8±8.43	79.607±8.58	0.327	0.05
BMI (kg/m)^2	31.43±1.84	30.15±1.68	<0.001	31.87±1.87	31.39±1.92	0.122	0.002
Waist circumference (cm)	97.13±6.60	96.37±6.62	<0.001	97.37±6.36	97.70±6.33	0.554	0.002
Hip circumference (cm)	101.47±5.24	101.03±4.96	0.017	101.33±5.45	101.43±5.39	0.448	0.05
PR per min	84.67±9.19	79.60±4.15	0.018	85.207±9.13	81.60±7.57	>0.05	0.025
SP (mmHg)	140.93±12.04	132.53±8.43	<0.001	140.00±11.26	138.20±10.06	>0.05	<0.001
DP (mmHg)	90.53±4.56	82.67±4.19	<0.001	88.93±4.40	86.67±3.44	>0.05	<0.001
FBS (mg/dl)	189.00±24.56	162.67±22.69	<0.001	196.40±30.06	183.33±22.00	0.745	<0.001
PPBS (mg/dl)	245.13±54.89	203.13±39.62	<0.001	257.87±47.88	235.87±42.74	0.145	<0.001
HbA_1c (%)	9.13±1.00	7.99±0.73	<0.001	9.55±1.25	8.71±0.87	0.876	0.006
Urea (mg/dl)	35.11±6.09	33.85±4.83	0.016	35.71±4.74	35.73±4.51	0.921	0.007
Creatinine (mg/dl)	1.09±0.22	0.97±0.21	0.001	1.07±0.18	1.06±0.16	0.792	0.05
Total cholesterol (mg/dl)	236.93±22.77	198.60±22.83	<0.001	245.67±21.73	213.80±21.7	0.135	<0.001
Triglycerides (mg/dl)	239.73±45.21	183.67±37.58	<0.001	249.33±44.43	195.27±35.89	0.221	<0.001
HDL (mg/dl)	33.20±15.87	47.00±10.88	<0.001	33.13±12.80	35.33±11.47	0.896	<0.001
LDL (mg/dl)	180.80±18.19	146.20±21.99	<0.001	180.60±17.88	171.87±18.62	0.325	<0.001
VLDL (mg/dl)	80.33±17.03	56.93±11.51	<0.001	78.53±16.81	74.07±15.64	0.844	<0.001

Data are expressed as mean±SD for 15 subjects in each group. SD: Standard deviation, BMI: Body mass index, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, VLDL: Very-low-density lipoprotein, PPBS: Postprandial blood sugar, PR: Pulse rate, SP: Systolic blood pressure, DP: Diastolic blood pressure, FBS: Fasting blood sugar, HbA_1c: Glycosylated hemoglobin

reason for fall in SP and DP. Few other studies have also reported findings that are similar to this study (Raghuraj & Telles, 2008; Sharma et al., 2013; Prakash & Gupta, 2015; Devi & Sarada, 2017).

Effect of yoga therapy on glycaemic values

Fasting, postprandial blood glucose and glycosylated hemoglobin levels decreased significantly in our subjects following the yoga therapy program. Such healthy reductions may be because of asanas and pranayama that can potentially improve insulin sensitivity in muscles and tissues as well as enhance peripheral glucose uptake and utilization. This finding is in agreement with earlier studies (Balaji, Ramanathan & Bhavanani, 2020; Raveendran, Deshpandae & Joshi, 2018; Madanmohan et al., 2012; Woodyard, 2011). Yoga reduces this risk by profile by decreasing activation of the sympathoadrenal system and the hypothalamic–pituitary–adrenal axis and also by promoting a feeling of well-being along with direct enhancement of parasympathetic activity via the vagus nerve (Innes & Vincent, 2007; Aljasir, Bryson & Al-Shehri, 2010).

Effect of yoga therapy on lipid profile

Yoga techniques promote lipolysis (breakdown of fats) and cause improvement in lipid profile by increased hepatic lipase and lipoprotein at cellular levels which alters the metabolism and increased uptake of triglycerides by adipose tissues (Santwana, Brajanath & Sukanta, 2014). Better ability to overcome stress resulting in lowered cortisol levels can be cited as a possible mechanism for improvement in lipid profile in patients practicing yoga (Shantakumari & Sequeira, 2013; Sahay, 2007; Bijlani, Vempati, Yadav, Ray & Gupta, 2005). Yoga techniques taught in this study have increased HDL cholesterol, preventing formation of plaques and thereby preventing atherosclerosis (Pal, et al., 2011).

Effect of yoga therapy on renal profile

A statistically significant difference in renal tests in yoga group as compared to control group has been found after 3 months of yoga training because of decrease in oxidative and psychological stress after yoga practices promote function of the kidneys. It helps to support renal artery blood flow by sustaining healthier blood and perfusion pressure. Such benefits may be attributed to a better sense of relaxation that induces vasodilatation by reducing sympathetic adrenergic vascular tone (Balaji et al., 2020). Similar findings were reported in other studies too (Pandey, Arya, Kumar & Yadav, 2017; Pandya, Nagrajappa & Ravi, 2016; Sengupta, 2012; Kashinath et al., 2014; Yurtkuran, Alp, Yurtkuran & Dilek, 2007).

Limitations

The present study is limited to small sample size as it is a pilot study. The study is limited to single center and further studies with more duration and sample size need to be done in future. Although a personal diary was maintained by the participants and checked by investigator to evaluate compliance, home practice varied between 10 to 30 min, and the number of days/week of home practice also varied. This interpersonal variability from patient to patient may also be considered as a limitation and kept in mind for future studies.

CONCLUSIONS

Yoga therapy is beneficial in improving the biochemical functions of the body and reducing metabolic risk factors, and hence, it could be applied as a secure and cost-effective therapeutic modality in combating MetS. Yoga as an adjuvant therapy given along with standard medical care may be considered in clinical practice as it is relatively safe and promotes holistic health and well-being.

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Conflicts of interest

There are no conflicts of interest.

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