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Effects of Yoga and Meditation on Clinical and Biochemical Parameters of Metabolic Syndrome

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ABSTRACT

The metabolic syndrome is a clustering of metabolic abnormalities associated with a risk of coronary artery disease, stroke and cardiovascular mortality. Since yoga and meditation have been used for the management of metabolic abnormalities and stress related illness, more scientific attitude is required to establish these techniques as adjunctive. 120 patients of metabolic syndrome were randomly selected to assess the efficacy of yoga and meditation. These patients were divided into two groups, one group underwent the standard treatment of diet, exercise and drug and the other group underwent daily yogic and meditational exercises in addition to the standard treatment. The following parameters were determined before and after the intervention – BMI, waist circumference, blood pressure, fasting blood sugar, HbA1c and lipid profile. In the group receiving yogic intervention, there was a significant decrease in BMI (31.74±2.03 to 29.71±1.93kg/m2, p<0.001), waist circumference (96.25±9.05 to 90.73±7.31cm, p<0.001), fasting blood sugar (208.71±60.15 to 152.20±16.52mg%, p<0.001), HbA1c (9.58±2.02 to 7.41±1.20%, p<0.001) systolic blood pressure (153.05±10.62 to 137.78±8.72mmHg, p<0.001), diastolic blood pressure (94.62±4.21 to 86.87±2.85mmHg, p<0.001), serum triglycerides (210.09±93.08 to 152.34±39.66mg/dl, p<0.001) and a significant increase in HDL-C (33.40±3.61 to 40.47±3.58mg/dl, p<0.001) when compared with the group taking only conventional measures. Based on results, yogic and meditational exercises may therefore, be considered as a useful adjunct to conventional therapy in management of metabolic syndrome.

***Keywords**: Metabolic Syndrome, Yoga and Meditation.*

Introduction

Metabolic syndrome is widely recognized according to NCEP ATP III guidelines (2004) which is given below:

Blood Pressure		≥140/≥90 mmHg
Waist Circumference	Males	>102 cm
	Females	> 88 cm
Triglycerides		>150 mg/dl
HDL Cholesterol	Males	< 40 mg/dl
	Females	<50 mg/dl
Fasting Plasma Glucose		>110 mg/dl

Insulin resistance is a hallmark of metabolic syndrome and is strongly associated with adiposity.[1,2] Hyperglycemia causes Na reabsorption and enhance the smooth muscle contractility. Hypertension in diabetic patients aggravates both macro and micro vascular diseases, especially nephropathy.[3] Various

authors have concluded that approx. 50-75 % of patients with essential hypertension have underlying insulin resistance.[4]

The possible mechanisms for insulin resistance are abnormal β-pancreatic cells, circulatory insulin antagonises and target tissue defects. There could be genetic or environmental causes of insulin resistance. It is more prevalent in urban than in rural areas. The reason could be the difference in the heredity, smoking, body fat and life style of city dwellers and villagers.[5]

Cross sectional and prospective data suggest that regular exercise can reduce the probability of development of type 2 diabetes mellitus and hypertension. Population studies have clearly demonstrated that the glucose tolerance is better in physically active persons than in inactive persons.[6]

Yoga is a complete way of life rather merely some 'asanas', has great potential to provide easy, user friendly stress management techniques. It also includes a vegetarian diet, likely to contain much less cholesterol and saturated fats as compared to western non-vegetarian diet. Yoga life style methods have a potential to be of great value in prevention and treatment of coronary artery diseases and controls several abnormalities of metabolic syndrome.[7]

Similarly, meditation the basic technique of 'Raja Yoga' is often looked upon as a relaxation technique to be used for treating stress and stress related illness. Transcendental meditation has been thoroughly investigated. The technique is defined as turning the attention inward towards the subtler level of a thought until the mind transcends the experience of the subtlest state of thought.[8] It is characterized by sensory and motor attenuation i.e. minimal cortical activity involving attention to a specific object.

Yoga and meditation have always been an essential part of life in traditional system of treatment but very little work has been done on these parameters and control of diseases. Therefore in present investigation researchers tried to elucidate the influence of yoga and meditation on clinical and biochemical parameters of metabolic syndrome with specific aim and objectives.

Material and Methods

This prospective randomized case control study was conducted in the School of Allied Health Sciences, Jaipur National University, Jaipur (Raj). 120 newly diagnosed patients were screened which have metabolic syndrome initially, these patients were stabilized by diet and exercise for one month. They were randomly devided into two groups (1) Control group: these patients were given conventional drug treatment and unsupervised exercise protocol. (2) Study group: patients besides conventional treatment was gone through supervised Yoga protocol. After three months 55 patients in study group and 46 patients in control group completed the study. 19 patients were dropped out[Fig 1]. Detailed history of each patients was obtained regarding the age, sex, year of diagnosis, age at onset and duration, associated risk factors and family history. Patients suffering from liver diseases, arthritis, pulmonary tuberculosis, malabsorption were excluded from the study.

The investigations were divided into three groups:

- Anthropometric measurement: Body mass index and waist circumference.
- Clinical investigations: Measurement of blood pressure by sphygmomanometer.
- Biochemical analysis: Fasting blood sugar, HbA_1c and lipid profile.

Weekly patients were evaluated for body mass index, waist circumference, fasting blood sugar and blood pressure. After 3 months HbA_1c and serum lipid profile were estimated.

Patients included in study group were asked to come daily or at least five times a week for continuous three months duration for a yoga course. It was supervised by trained yoga faculty member.

Yoga Protocol

- Health rejuvenating exercises (5 Mins.)
- Body Posture (Asanas)

(a)	Surya Namaskar/ Parmeshwar Vandana	(3 min.)
(b)	Vajrasana	(3 min.)
(c)	Suptpawan muktasana	(3 min.)
(d)	Bhujangasana	(3 min.)
(e)	Dwipaduttanasana	(3 min.)

(f)	Yogmudra	(3 min.)
(g)	Vakrasana	(3 min.)
(h)	Pashehimottanasana	(3 min.)
(i)	Konasana	(3 min.)
(j)	Sarwangasana	(3 min.)

- Abdomen exercises (7 min.)
- Relaxation exercise

(a)	Shavasana	(15 min.)
(b)	Transcendental meditation	(5 min.)

Statistical analysis

The data were expressed as mean ± SD. Statistical analysis were performed according to an intention to treat strategy. Quantitative data were presented as mean ± SD and the student's 't' test was used to compare the difference. All p values were 2 tailed, p value <0.05 was considered significant.

Observations and Results

The baseline parameters of both groups were similar in respect to mean age, sex, BMI, Waist circumference, glycemic control and lipid profile [Table 1].

At the end of three months the study group showed significant improvement in BMI. Mean value of BMI of control group was 31.53±3.69 kg/m^2 whereas in study group it was 29.71±1.93 kg/m^2 ($p<0.05$). After three months the waist circumference 93.37±8.53 and 90.73±7.31 cm in control and study group ($p<0.5$). Hypertension was found to be well treated in the study group i.e. 146.39±4.17 mmHg and 137.78±8.72 mmHg were the mean values of systolic blood pressure ($p<0.001$) and 93.39±3.29 mmHg and 86.87±2.85 mmHg were the recordings of diastolic blood pressure ($p<0.001$).

Yoga and meditation also have good influence on biochemical parameters like mean fasting blood sugar in control group was 164.80±27.17 mg% and after yoga therapy in study group it was 152.20±16.54 mg% ($p<0.05$). HbA_1c did not appear to be as improved significantly as the other parameters (8.15±1.29 % in control group, 7.41±1.20 % in study group; $p<0.2$). Mean values of serum triglyceride also showed the significant differences after three months (186.46±51.96 mg% in control group, 152.34±39.66 mg%; $p<0.001$). The beneficial cholesterol i.e. HDL cholesterol levels were significantly higher in study group patients (36.78±4.17 mg% and 40.47±3.58 mg% in control and study groups respectively; $p<0.001$) [Table 2].

The recordings at pre and post treatment showed that there was highly significant improvement in all parameters of study group patients. Likewise in waist circumference (96.25±9.05 to 90.73±.31 cm; $p<0.001$), systolic blood pressure (153.05±10.62 to 137.78±8.72 mmHg; $p<0.001$), diastolic blood pressure (94.62±4.21 to 86.87±2.85 mmHg; $p<0.001$); fasting blood sugar (208.71±60.15 to 152.20±16.52 mg%; $p<0.001$), HbA_1c (9.58±2.02 to 7.41±1.20 %; $p<0.001$), serum triglyceride (210.09±93.08 to 152.34±39.66 mg%; $p<0.001$) and serum HDL-C (33.40±3.61 to 40.47±3.58 mg%; $p<0.001$) [Table 3].

The differences of initial and final readings were also statistically compared. There was more difference obtained in the case of study group. For instance, in waist circumference the decline was 3.61 cm in control group and 5.53 cm in study group with the p value <0.001. Likewise in systolic blood pressure (6.22 and 15.27 mmHg respectively; $p<0.001$), diastolic blood pressure (2.57 and 7.75 mmHg; $p<0.001$), FBS (36.66 and 56.51 mg%; $p<0.05$), HbA_1c (0.74 and 2.17 %; $p<0.01$), triglyceride (35.15 and 57.75 mg%; $p<0.1$), HDL-C (3.93 and 7.07 mg%; $p<0.001$) [Table 4]. The weekly recordings are also being displayed by graphical representation.

Discussion

In our study we have got the significant improvement in anthropometric parameters in the case of study group. Divekar M et al reported a significant improvement in body weight and another anthropometric indices after the yoga based intervention in healthy population. They observed that yogic practice was associated with 1.5 to 13.6% reduction in body weight.[9] Murugesonet al found the beneficial effects of yogic intervention on body weight and composition in hypertensive patients.[10]

Satyanarayanet al observed the effect of Santhi Kriya on certain psycho-physiological parameters. Santhi Kriya is a mixture of combined Yogic practices of breathing and relaxation. Their results indicated a gradual and significant decrease in the body weight from 1st to 30th day (P<0.001) and an increase in alpha activity of the brain (P<0.001) during the course of 30 days of Santhi Kriya practice.[11]

Some other Indian workers studied the body composition, cardiovascular endurance and anaerobic power of Yogic practitioners, 40 male high school students, age 12-15 years, for one year duration and the result of ANOVA revealed that a significant improvement in ideal body weight, body density, cardiovascular endurance and anaerobic power was observed as a result of Yoga training. They showed significant change in body fat evident that some of the fat folds (triceps, subscapular, suprailiac, umbilical, thing and calf) and body circumference (waist, umbilical, hip) were reduced significantly.[12]

In contrast with these positive findings, an uncontrolled 8 weeks trial studies of 10 U.S. University students did not show any significant findings may be due to the lower number of study subjects and loss of follow up.[13]

In a study 20 non-insulin dependent diabetics were selected. For 40 days Yogasanas regimen included 13 specific asanas. The subjects serum insulin, plasma fasting and one hour post prandial blood glucose levels and anthropometric parameters were measured before and after Yogasana. A significant decline in waist to hip ratio along with changes in insulin levels, fasting and post prandial sugar were also observed, suggesting a positive effect of Yogasanas on glucose utilization and fat redistribution in NIDDM.[14]

The significant increases in ideal body weight and body density may be due to the fact that Yogic training reduces the body fat which is inversely proportional to ideal body weight and body density. Such findings in turn suggest that as a result of Yoga training, girth/ circumference of fat deposited area will reduce.[15]

We also observed the effective role of yoga and meditation on hypertension. Researchers indicated the beneficial effect of bio-feedback aided behavioural methods in reducing the mild hypertension. They included hypertensive patients-along with other CVD risk factors and had demonstrated significant pressure decline, among the subject receiving behavioral Yoga therapy versus control receiving usual care.[16]

In another random study Murugeson et al assigned 33 hypertensives into three groups. The experimental group I underwent selected Yoga practices, experimental group II received medical treatment by the physician and the control group did not participate in any of the treatment stimuli. Yoga imparted in the morning and in the evening with 1 hour session for a total period of 11 week. Medical treatment comprised drug intake everyday in the whole experimental period. The result of pre-post hoc test with ANCOVA revealed that both the treatment stimuli (i.e. Yoga and drug) were effective in controlling the variables of hypertension.[10]

Negative findings in a three months study in participants completing a Yoga programme compared with those receiving an aerobic exercise programme were also observed. No impact on blood pressure but a significant reduction in heart rate and increase in heart rate variability in participants completing a Yoga programme were reported in those findings.[17]

The beneficial effect of yogic lifestyle intervention on blood pressure has been supposed to be due to:

- Parasympathetic predominance which has been proposed by Joshep et al. They observed the increased activity level of monoamine oxidase along with reduction in dopamine-□-hydroxylase.[18]
- Increased baroreflex sensitivity, a study conducted by selvamerthy et al demonstrates that the sluggish baroreflex mechanism observed in patients of essential hypertension can be reactivated by a 3 week course of orthostatic tilt or selected yogic postural exercises thereby restoring the BP to normal level.[19]
- Decreased arterial tone and peripheral resistance resulted by the Raja yoga (meditation) may be the another reason for a fall in diastolic blood pressure.[20,21]

Our study indicates that yoga and meditation are also effective for biochemical parameters of metabolic syndrome. NarukaJ et al documented the reductions in fasting blood glucose among the

subjects receiving a Yoga based intervention versus controls having no active intervention. The changes in lipid profile including reduction in total cholesterol and LDL cholesterol and increases in HDL cholesterol also observed.[22]

The effective role of Yoga in modifying certain cardio vascular function in type 2 diabetics was reported. Singh S et al worked upon the 24 type 2 diabetes mellitus cases who were on antihyperglycemics and dietary regimen. They were trained in Yogasanas and pursued those 30-40 min./day for 40 days under guidance. The indicated result was a significant decrease in fasting blood glucose levels from basal 190.08±18.54 mg/dl to 141.5±16.3 mg/dl after Yoga regimen. The post prandial glucose level also decreased along with glycosylated hemoglobin.[23]

Bijlani RL et al observed the short-term impact of 8 days yoga life style modification programme for prevention and management of chronic metabolic diseases. The intervention consisted of asanas, Pranayama, relaxation techniques, group support individualized advice, meditation, stress management and nutrition. They concluded that fasting plasma glucose, serum total cholesterol, LDL, cholesterol VLDL-cholesterol, the ratio of total cholesterol to high-density lipoprotein cholesterol, and total triglycerides were significantly lower, and HDL-cholesterol significantly higher. The changes were more marked in subjects with hyperglycemia and hypercholesterolemia.[24]

Yoga asanas in combination with conventional medical treatment provides a better metabolic control. It improves the status of type 2 diabetes mellitus probably by more than one way either by increased sensitivity of the β-cell of pancreas to glucose signal or may be directly rejuvenating for these cells. As a result yoga may increase the utilization and metabolism of glucose in the peripheral tissues through enzymatic processes.[25,26]

In summary our study indicates that yoga and meditation confer significant benefits in clinical and biochemical parameters of metabolic syndrome and can be used as an adjunctive therapy in the management of metabolic disorders.

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Table 1: Baseline characteristics

Parameters		Initial (0 month)		
		Control group (Mean ± SD)	Study group (Mean ± SD)	p value
Age (yrs.)		53.97 ± 11.22	54.05 ± 8.83	< 0.4
Sex (M/F)		26 M, 20F	25M, 30F	NS
BMI (kg/m^2)		32.18 ± 3.53	31.74 ± 2.03	< 0.1
Waist Circumference (cm)		96.98 ± 9.54	96.25 ± 9.05	< 0.6
Blood Pressure (mmHg)	**Systolic**	152.6 ± 8.73	153.05 ± 10.62	< 0.2
	Diastolic	95.96 ± 2.25	94.62 ± 4.21	< 0.2
Glycemic Control	**FBS (mg%)**	201.46 ± 65.80	208.71 ± 60.15	< 0.2
	HbA$_1$c (%)	8.89 ± 1.68	9.58 ± 2.02	< 0.1
Lipid Profile (mg%)	**Cholesterol**	264.54 ± 15.52	261.89 ± 14.94	< 0.8
	Triglyceride	221.61 ± 104.65	210.09 ± 93.08	< 0.6
	HDL-C	32.85 ± 4.10	33.40 ± 3.61	< 0.1
	LDL-C	187.37 ± 21.24	166.47 ± 22.68	< 0.8
	VLDL-C	44.32 ± 20.93	42.02 ± 18.62	< 0.6

Table 2: Comparison of different parameters between control and study group at post treatment

Parameters		Final (3 months)		
		Control group (Mean ± SD)	Study group (Mean ± SD)	p value
BMI (kg/m^2)		31.53 ± 3.69	29.71 ± 1.93	< 0.05
Waist Circumference (cm)		93.37 ± 8.53	90.73 ± 7.31	< 0.5
Blood Pressure (mmHg)	Systolic	146.39 ± 4.17	137.78 ± 8.72	< 0.001
	Diastolic	93.39 ± 3.29	86.87 ± 2.85	< 0.001
Glycemic Control	FBS (mg%)	164.80 ± 27.17	152.20 ± 16.54	< 0.05
	HbA_1c (%)	8.15 ± 1.29	7.41 ± 1.20	< 0.2
Lipid Profile (mg%)	Cholesterol	230.04 ± 51.96	210.38 ± 12.84	< 0.001
	Triglyceride	186.46 ± 51.96	152.34 ± 39.66	< 0.001
	HDL-C	36.78 ± 4.17	40.47 ± 3.58	< 0.001
	LDL-C	155.97 ± 22.57	139.44 ± 14.03	< 0.05
	VLDL-C	37.29 ± 10.39	30.47 ± 7.93	< 0.05

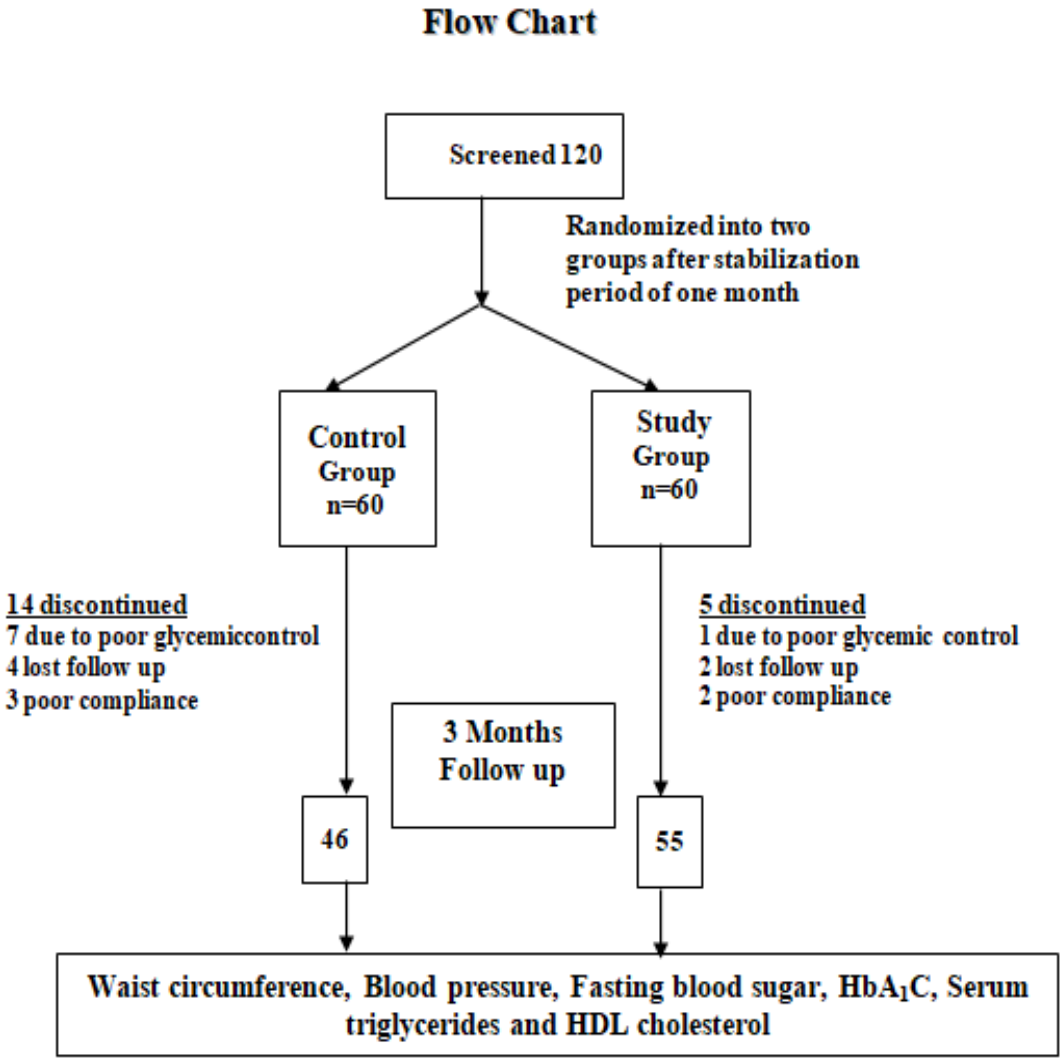
Table 3: Effect of Yoga and meditation on various parameters

Parameters		Study group		p value
		0 month (Mean ± SD)	3 months (Mean ± SD)	
Waist Circumference (cm)		96.25 ± 9.05	90.73 ± 7.31	< 0.001
Blood Pressure (mmHg)	SBP	153.05 ± 10.62	137.78 ± 8.72	< 0.001
	DBP	94.62 ± 4.21	86.87 ± 2.85	< 0.001
Fasting Blood Sugar (mg%)		208.71 ± 60.15	152.20 ± 16.52	< 0.001
HbA_{1C} (%)		9.58 ± 2.02	7.41 ± 1.20	< 0.001
Serum Triglyceride (mg%)		210.09 ± 93.08	152.34 ± 39.66	< 0.001
Serum HDL – C (mg%)		33.40 ± 3.61	40.47 ± 3.58	< 0.001

Table 4: Comparison between mean differences of Control and Study group

Parameters		Control group (Mean difference)	Study group (Mean difference)	p value
BMI (kg/m^2)		0.65	2.03	<0.001
Waist Circumference (cm)		3.61	5.53	<0.001
Blood Pressure (mmHg)	Systolic	6.22	15.27	<0.001
	Diastolic	2.57	7.75	<0.001
Glycemic Control	FBS (mg%)	36.66	56.51	<0.05
	HbA_1c (%)	0.74	2.17	<0.01
Lipid Profile (mg%)	Triglyceride	35.15	57.75	<0.1
	HDL-C	3.93	7.07	<0.001

Figure 1: Diagrammatic presentation of study design



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