

# Effect of Yoga on Metabolic Syndrome

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**Abstract-** Metabolic syndrome is now considered as 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. People with metabolic syndrome have five times greater risk of developing Type II diabetes. Diabetes is considered as fourth or fifth leading causes of death in the developed world and Cardiovascular Diseases represents the first leading cause of death in the world in men and women. Modern urban diet and physical inactivity are underlying key factor to develop metabolic dysfunction of our body. Yoga, the ancient Vedic science was developed in India for improving spiritual health and wellbeing. In recent times yoga is widely used to improve health and to prevent and cure disorders. Yoga asana or specific posture, pranayama or controlled breathing and dhyana or meditation practice has its own specific and overall benefits. Yoga asana uses various postures to improve physical strength, flexibility, balance, co-ordination and endurance. Hence the present study was undertaken to find out the effect of yoga therapy in metabolic syndrome.

Diagnosis of Metabolic Syndrome was based on according to the modified South Asian guidelines of the United States National Cholesterol Education Program (NCEP) Expert Panel Adult Treatment Panel (ATP). Total 135 subjects within the age group 15-65yrs those are fulfilled the criteria for research was recruited in this study. After recruitment participants grouped as i) yoga with diet group ii) only yoga group and iii) control group advised to follow the yoga training scheduled for 6 months and every 3 months interval for anthropometric and biochemical measurements. Subjects who assigned to the yoga with diet group, and only yoga group, yoga intervention comprised of Asanas (physical posture), Pranayama (breathing techniques), Meditation, for about 1 hour a day and 5 days in a week. Control group did nothing only to maintain as usual daily living during the study.

After 6 months study result shows statistically and clinically significant. The analysis of data obtained from base line, after 3 months and after 6 months has been done using STATA11.1, statistical software it was observed that body weight ( $p < 0.01$ ), BMI ( $p < 0.1$ ), Waist circumference ( $p < 0.01$ ), systolic blood pressure ( $p < 0.01$ ), fasting blood sugar ( $p < 0.05$ ) significantly decreased in Yoga with diet group in comparison to control as well as only yoga group. Only yoga group also shows improvement in comparison to control group. No significant changes were observed between or within all groups for triglycerides and HDL.

Yoga is beneficial in maintaining good health and wellbeing by regulating body weight, improving Biochemical parameters and helpful to overcome the obesity related complications as well

as metabolic risk factor. Yoga could be beneficial to prevent or delayed onset of Type-2 diabetes and cardio vascular diseases.

**Index Terms-** Body Mass Index, Insulin Resistance, Metabolic Syndrome, Obesity, Yoga Therapy.

## I. INTRODUCTION

Metabolic syndrome is now considered as 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<sup>1</sup>. Metabolic syndrome is a deranged condition of energy utilization and storage of the body, which promotes to develop some correlated medical conditions like, elevated fasting plasma glucose, central obesity, high serum cholesterol (Triglyceride) and low high density cholesterol level (HDL), elevated blood pressure<sup>2-5</sup> and over time (estimated 3 to 10 years) strikes fatally as Cardiovascular Diseases and Type II Diabetes which are considered as twin global epidemic<sup>1</sup>. Modern urban diet and physical inactivity are underlying key factor to develop metabolic dysfunction of our body. People with metabolic syndrome have five times greater risk of developing Type II diabetes<sup>6</sup>. Diabetes is considered as fourth or fifth leading causes of death in the developed world and Cardiovascular Diseases represents the first leading cause of death in the world in men and women<sup>10</sup>. Recent studies show that the worldwide prevalence of Diabetes Mellitus appears to be increasing alarmingly. It is estimated that 5.4% of the total population would be affected with the disease by the year 2025. It is estimated that by the year 2030 maximum number of diabetic patient will be in India in comparison to the other countries of the Globe and in 2015 Cardiovascular disease (CVD) will be the single most leading cause of death in India<sup>7</sup>. Yoga, the ancient Vedic science was developed in India for improving spiritual health and wellbeing<sup>11</sup>. In recent times yoga is widely used to improve health and to prevent and cure disorders. Yoga asana or specific posture, pranayama or controlled breathing and dhyana or meditation practice has its own specific and overall benefits. Yoga asana uses various postures to improve physical strength, flexibility, balance, co-ordination and endurance<sup>13</sup> and can be used as a moderate- intensity exercise for patients with limited vital capacity or restricted ability to exercise<sup>14</sup>. Apart from these above-mentioned benefits, yoga has further proved its usefulness to decrease hypertension and cardiac inflammation, and improve cardiac function, stabilize the sympathetic nervous system and improve psychological health.<sup>15-17</sup>

American College of Sports Medicine (ACSM) and Centre for Disease Control (CDC) suggest moderately intense physical activity for obese subjects,<sup>18,19</sup> because exercise training has been

shown to improve metabolic risk factor in subjects with obesity.<sup>20- 23</sup> Practice of yoga increases muscle strength and cardio- respiratory fitness and has limited side effects. This is a cost effective training programme because it requires virtually no equipment.<sup>13, 25</sup>

Limited information is accessible regarding the effects of yoga training on metabolic syndrome or metabolic risk factor including hypertension, high blood sugar, dyslipidemia in obese subjects. Accordingly, I hypothesized that yoga exercise training may have beneficial effects on metabolic parameters in overweight and obese subjects. Therefore, I evaluated the effect of yoga exercise training on body composition, lipid profile, fasting blood sugar in overweight and obese subjects for a period of six months.

## II. METHODS

Study was conducted at Nirmala Arogya Kendra yoga clinic. Diagnosis of Metabolic Syndrome was based on according to the modified South Asian guidelines of the United States National Cholesterol Education Program (NCEP) Expert Panel Adult Treatment Panel (ATP)., in which an individual diagnosed with metabolic syndrome has three or more of the following characteristics<sup>3</sup>.

- 1) Central obesity (waist circumference exceeds 90cm or 80 cm for Asian male and female, respectively)
- 2) Hypertension (systolic pressure equals or exceeds 130 mmHg or diastolic pressure equals or exceeds 85 mmHg)
- 3) Elevated blood glucose (Fasting glucose level equals or exceeds 5.5 mmol /L [ 100 MG/DL])
- 4) Elevated plasma triglyceride level (equals or exceeds 1.70 mmol /L [150 mg/dl]) and
- 5) Low level of high density lipoprotein – cholesterol (HDL-C); level equals or is less than 40 mg/ dl for male and 50 mg/ dl for female

Subjects were explained about the potential risks and benefits of their participation, and written informed consent was taken as a voluntary basis before the study began.

Body weight (with light clothes and without footwear) measured using pedestal type scale having an accuracy of 10gm. Height(without footwear) measured using a vertical scale, BMI calculated from the formula:  $BMI = Wt(kg)/Ht(m)^2$ , BMR and % body fat measured using bio-impedance technology. For waist/hip circumference ratio (W/H), waist circumference (in cm) measured at the level of the umbilicus in the erect position. The hip circumference measured 4 cm below the anterior superior iliac spine (i.e., the bony prominence at the front of the hip with underclothing on). Heart rate and Blood pressure recorded after ten minutes of supine rest by a mercury sphygmomanometer .Blood sample was collected to measure the bio-chemical parameters (fasting blood sugar, fasting insulin, HbA1c, Lipid profile) blood sample preserved properly with standard mechanism and set for test within 4 hours after sample collection.

Total 135 subjects within the age group 15-65yrs those who fulfilled the criteria for research were recruited in this study. After recruitment participants grouped as i) yoga with diet group ii)only yoga group and iii)control group were advised to follow the yoga training schedule for 6 months and in every 3 months interval they were asked to report for anthropometric and biochemical measurements. Subjects who were assigned to the yoga with diet group, yoga intervention comprised of Asanas (physical posture), Pranayama (breathing techniques), Meditation, for about 1 hour a day and 5 days in a week. This group was advised to take yogic concept of diet i.e. more Sattvik food, comprising of complex carbohydrate, more fruits and vegetables, there should be restriction of extra oil, sugar and sweet product and high glycaemic food. There should be complete restriction of taking Tamasik food or alcohol, beverage etc. Yoga group followed the same yoga intervention as yoga with diet group but they were not asked to follow the dietary restriction. Control group were not advised to practice yoga or diet within 6 months, they maintained their daily activity . They came only for periodic check-ups at 3 months interval for 6 months duration.

## III. RESULTS

The present study involved the assessment of the effect of yoga therapy on metabolic syndrome risk factors in overweight individuals. The present study showed that the individual with metabolic risk factors significantly reduces their body weight, abdominal obesity, systolic blood pressure, fasting blood sugar level.

The analysis has been done using STATA 11.1, statistical software. I have approached to use the difference-in-differences estimation, a useful technique in the field of statistical analysis of baseline and follow-up surveys. First, this technique measures the mean (average) and standard deviations (SD) of all the variables. Secondly, this allows to measure the difference(s) in between mean and SD of variables, phase-wise. Not only that, but also it calculates the difference of phase-wise differences. Finally, it detects the effect of treatment how significant it is.

For example, at the baseline survey i.e. at phase I, I have taken ninety patient's data on few medical outcomes when no treatment is started. There were differences in mean and SD, which is summarised in table 1. Now after 6 months treating thirty patients with Yoga & Diet, thirty with Only Yoga; and thirty without any such prescription, I again surveyed the same and see the differences in mean and SD. To assess the sole effect of treatment on different medical outcomes, the difference-in-differences technique has been especially used.

I have analysed two things –

1. Significance of Yoga & Diet:
  - In comparison to Control group patients between Check-up Phase I & III.
2. Significance of only Yoga:
  - In comparison to Control group patients between Check-up Phase I & III.

**Results from analysis:**

**Table 1: Summary Statistics of information collected over different Check-up Phases**

Check-up Variables ↓	Phases →	Yoga & Diet prescribed Patients		Only Yoga prescribed Patients		Control Group Patients – prescribed <i>nothing</i>	
		Check up Phase I	Check up Phase III	Check up Phase I	Check up Phase III	Check up Phase I	Check up Phase III
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Weight		68.4±12.1	65.6±11.9	71.9±11.8	70.9±11.3	74.4±10.6	74.9±10.6
BMI		29.0±5.7	27.5±5.1	28.3±3.9	27.7±3.4	29.3±3.3	29.5±3.3
Systolic BP		131.4±12.5	122.2±8.6	133.5±11.5	127.2±8.8	134.7±6.9	134.2±5.9
Diastolic BP		83.9±7.5	80.0±6.5	84.6±6.5	81.4±6.4	85.2±4.6	83.9±4.3
WC		97.0±3.8	91.4±3.5	98.3±2.5	96.3±2.6	99.1±2.3	99.8±2.3
FBS		102.8±11.2	99.1±8.1	124.4±31.1	122.4±32.3	116.7±41.3	122.4±55.8
HDL		43.5±9.9	47.7±8.6	44.2±12.7	45.7±11.5	48.4±11.1	47.2±9.7
Triglycerides		124.0±58.0	121.9±52.8	147.8±64.0	138.9±71.7	140.0±46.6	141.5±45.6

**Table 2: Significance of Yoga with Diet in comparison to Control group patients between Check-up Phase I & III**

Variable specific significance (P-value)	Chek-up Phase I	Chek-up Phase III	Difference-in-Differences
	Difference between Control and Diet & Exercise Patients	Difference between Control and Diet & Exercise Patients	
Weight	0.043**	0.002***	0.412
BMI	0.827	0.079*	0.274
Systolic BP	0.147	0.000***	0.008***
Diastolic BP	0.394	0.012**	0.234
WC	0.304	0.000***	0.027**
FBS	0.133	0.012**	0.462
HDL	0.055*	0.834	0.131
Triglycerides	0.226	0.14	0.85

Note: \*\*\* P < 0.01: \*\*\* signifies at 1 per cent level of significance

\*\* P < 0.05: \*\* signifies at 5 per cent level of significance

\* P < 0.1: \* signifies at 10 per cent level of significance

Table 2 shows that the diet and exercise has significant effects on the difference between treated and non-treated patients. At the phase-III, the treatment is found out to be highly significant at 1 per cent level of significance in case of weight, systolic blood pressure and waist circumferences. Again, the treatment has moderate significance over diastolic blood pressure and FBS. Difference-in-differences technique also detects the significance levels of the treatment in pre- and post-treatment differences between patients. It is found that due to the treatment

of diet & exercise, the difference-in-differences of systolic BP and waist circumference has been affected significantly. In other terms, when our null hypothesis ( $H_0$ ) is that diet & exercise have *significant* effect on patients' medicinal outcomes compared to the control group patients; then there is a mere 0.8 per cent chance of being not true i.e. 99.2 per cent of studies will confirm that due to treatment, difference in systolic blood pressure significantly decreases compared to that of control group patients (as P-value=0.008).

**Table 3: Significance of Yoga in comparison to Control group patients between Check-up Phase I & III**

Variable specific significance (P-value)	Chek-up Phase I	Chek-up Phase III	Difference-in-Differences
	Difference between Control and Exercise Patients	Difference between Control and Exercise Patients	
Weight	0.394	0.164	0.702
BMI	0.291	0.048**	0.51
Systolic BP	0.587	0.002***	0.065*
Diastolic BP	0.694	0.089*	0.352
WC	0.624	0.029**	0.226
BS	0.467	0.993	0.603
HDL	0.153	0.616	0.509
Triglycerides	0.609	0.864	0.628

Note: \*\*\* P < 0.01: \*\*\* signifies at 1 per cent level of significance

\*\* P < 0.05: \*\* signifies at 5 per cent level of significance

\* P < 0.1: \* signifies at 10 per cent level of significance

Table 3 shows that the exercise has significant effects on the difference between treated and non-treated patients.

#### IV. DISCUSSION

The present study confirmed the positive effect of yoga therapy as a conventional modality of treatment on biochemical imbalances and effective in reducing the risk factors of metabolic syndrome in overweight subjects.

Body Mass Index provides a simple calculation to detect the persons “fatness” or “thinness”, allowing health professionals to discuss over and under weight problems more objectively with their patients. Excessive body weight or obesity is associated with chronic storage of excess calorie<sup>1</sup> and lack of physical activity is pivotal in its development<sup>2</sup>. From various studies it is confirmed that obesity is one of the main risk factor for insulin resistance or metabolic syndrome and over time which leads to several chronic and morbid diseases including heart diseases, diabetes II, hypertension, stroke, gall- bladder diseases, osteoarthritis, cancer and also associated with high blood cholesterol, in female complications of pregnancy, menstrual irregularity, hirsutism, stress incontinence etc. The epidemic of obesity in adolescents and adult population has been expanded in the past several years<sup>3</sup>, raising in body fat mass during adolescents may be related to the development and acceleration of metabolic risk factor including hyperlipidemia and insulin resistance along with cardiovascular diseases and diabetes type II.<sup>4,5</sup> Long term insulin resistance may cause type II diabetes and subsequent acceleration of morbidity and impaired glucose tolerance.<sup>7</sup> Thus controlling is crucial for the reduction of future health problem and morbidity.<sup>8,9</sup>

The significant reduction in the Body weight, BMI and Waist circumference as recorded in the present study are in line with the earlier studies, wherein, a 6-day yoga programme led to decreased Body Mass Index (BMI), Waist and hip circumference, Fasting blood sugar level<sup>32</sup>. Med Sci Monit 2010; 16:35-40.) According to yoga, the root causes of the

abnormalities are adhi or mental stress. Due to high stress the person habituates over eating leading to the deposition of fat in the body. Excess fat is undoubtedly related with metabolic dysfunction of our body and promotes to develop metabolic risk factors. To combat with overweight or metabolic risk factors one has to reduce stress, increase physical activity and regulate diet. The practice of yoga can regulate the body functions in a balanced manner and helpful in providing sustainable health. Analysis of the results of my study clearly indicate that the complications of overweight and metabolic risk factors can be reduced by yoga therapy. The reduction in the body weight might be due to reduction in the deposited fat on adipose tissue.

A reduction in the FBS after the practice of 6 months yoga indicated the improvement in the biochemical functions in overweight individuals. His findings are similar to the findings of Malhotra et al. who showed that yoga asanas significantly decreased FBG concentrations in type-2 Diabetic patients after forty days<sup>33</sup>

#### V. CONCLUSION

The prevalence of obesity is increasing among all ages, including the elderly. Research has proved that people with metabolic syndrome have five times greater risk of developing Type II diabetes<sup>6</sup>. Diabetes is considered as fourth or fifth leading causes of death in the developed world and Cardiovascular Diseases represents the first leading cause of death in the world in men and women<sup>10</sup>. Yoga therapy is beneficial in maintaining good health by regulating BMI, improving the biochemical functions of the body and helpful to overcome the complications of obesity and reduces the metabolic risk factors. This may have direct impact on the use of yoga therapy as a safe and cost-effective therapeutic modality in combating metabolic syndrome and obesity.

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