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Effect of Integrated Yoga Practices on Anthropometric Measures, Serum Lipid Profile and Oxidative Stress Status in Obese Adults

KEYWORDS: Obesity, Yoga, Body Mass Index, Oxidative stress

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ABSTRACT *Obesity is a chronic medical condition results from excess accumulation of fat producing adverse effect on health. A major cause of obesity was found to be improper lifestyle and stress, leading to excessive lipid peroxidation, indicating increased production of reactive oxygen species (ROS), generating oxidative stress. This study was undertaken to find out the effect of integrated yogic practices on anthropometric measures, serum lipid profile and oxidative stress in obese individuals. A total of 112 subjects (group average age in years, 29.81±3.10) with BMI, ≥25 to ≤40 were selected for the study for a single group pre-post trial. The subjects had undergone yogic intervention for one hour in the morning for three months. The changes in anthropometric measurements, serum lipid profile, serum total antioxidant capacity and malondialdehyde (MDA) levels as a marker of oxidative stress were estimated before and after three months of yoga therapy. The data obtained was verified for normal distribution and analysed using paired t-test for normally distributed data and Wilcoxon signed rank test for non-normally distributed data with SPSS (Version 20.0) package. Significant changes were observed in the body weight, BMI, waist circumference, total cholesterol, triglycerides, LDL cholesterol, total antioxidant capacity and MDA both in male and female subjects after yogic practices. The study demonstrates the efficacy of yogic practices on BMI, lipid profile and oxidative stress markers in patients with obesity and suggests that yogic practices may have therapeutic and protective effects on obesity by decreasing serum lipid profile and oxidative stress.*

Introduction

Overeating energy-dense, nutrient-poor foods and a sedentary lifestyle have led to an epidemic of obesity all over the world (Gronning *et al,* 2013). Obesity is defined as an excess accumulation of fat due to positive energy balance, resulting from energy intake that exceeds the energy expenditure, leading to adipocyte hypertrophy and hyperplasia, stress and inflammation within the adipose tissue (WHO, 2009). The prevalence of adolescent and adult obesity is increasing at an alarming rate in India and other South Asian countries (Prasad *et al,* 2012); 30 to 65 % of urban Indian population are overweight or obese (Chopra *et al,* 2002). Epidemiologists found that young people are prone to obesity and are at risk for a series of lifestyle diseases (Ogden *et al,* 2012). Obesity may impair health and increases the risk of morbidity from several pathologies and it's the 5th leading risk for death globally(WHO, 2013).

Epidemiological, clinical, and animal studies have shown that obesity is coupled with altered redox state and increased metabolic risk (Warolin *et al,* 2014). Oxidative stress can be a consequence, but also a trigger of obesity. Chronic hyper nutrition, high fat- high carbohydrate meals, as well as high dietary saturated fatty acids and trans-fatty acids, stimulate intracellular pathways, leading to oxidative stress through multiple biochemical mechanisms (Sies *et al,* 2005). Increased oxidative stress in accumulated fat is an important pathogenic mechanism of obesity-associated diseases (Furukawa *et al,* 2004). Chronic stress, combined with positive energy balance, may be a contributor to the increased risk for obesity, especially upper body obesity, and other metabolic diseases (Bose *et al,* 2009). It is known that weight reduction decreases oxidation markers, increases antioxidant defences and improves metabolic and cardiovascular risks associated with human obesity (Bigornia *et al,* 2010).

Though there are many non-invasive and non-pharmaceutical treatment options available (Tzotzas *et al,* 2011), yoga has been shown to be a simple and economical therapeutic modality that may be considered as a beneficial adjuvant for obesity (Telles *et al,* 2010). Yoga therapy is the two fold therapeutic system that prevents and cures various diseases through practice of yoga system. This system concentrates on purification of body and mind, through this integrated holistic approach, one can overcome almost all kinds of afflictions in life (Suchetha *et al,* 2011). The ancient Indian science of yoga is a way of life which includes changes in mental attitude, diet, and the practice of specific techniques such as yoga postures (*asanas*), breathing practices (*pranayamas*), and meditation (Telles *et al,* 2010). A combination of yoga practices which emphasized breathing techniques was shown to reduce the body mass index (BMI) in obese persons after yoga intervention (Gokal *et al,* 2007). So, yoga may be an attractive alternative exercise training program to reduce the body weight and stress level without any side effects (Collins, 1998). Hence this study was undertaken to study the effect of integrated approach of yogic practices on anthropometric variables, body composition and oxidative stress in obese adults.

Materials and Methods

Participants

A total of 112 subjects (group average age in years, 29.81±3.10) with BMI, ≥25 to ≤40 were recruited for the study for a single group pre-post trial that have enrolled in yoga camps. None of them had done yoga before. The selection criteria included: a). BMI ≥25 to ≤40 kg/m^2), b). Absence of a disease which could have contributed to obesity (e.g., hypothyroidism, polycystic ovarian syndrome), and c). No conditions which required treatment which could have resulted in weight gain (e.g., conditions which required treatment with steroids). The study design was explained to them and they gave their signed consent to participate. The study was approved by the ethics committee of the institution.

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Assessments

Body Mass Index: The body mass index (BMI) was calculated as the body weight (in kg), in light clothing and without shoes, divided by height (in metres) squared. Body weight was measured to 0.05 kg using an electronic balance (GTEP Essae, Eeroka Ltd). Height was measured to the nearest 0.1 cm (Anthropometric tape, Global medical devices, Maharashtra.).

Waist circumference: The waist circumference was measured to the nearest 0.1 cm in a horizontal plane midway between the inferior costal margin and the iliac crest.

Hip circumference: The hip circumference was measured around the pelvis at the point of maximal protrusion of the buttocks. The ratio of the waist circumference to the hip circumference was derived and is a ratio between the fat stored centrally inside the abdomen (waist circumference) and fat stored peripherally (hip circumference).

Biochemical measurements: For biochemical estimations, about 5 ml of venous blood was collected from all the participants before and after the yoga practice and the serum was used for the estimation of lipid profile using (ERBA Lipid Profile Reagents, TransAsia bio-medicals) and total antioxidant capacity and lipid peroxidation using commercially available kits.

Intervention

Participants of the study have undergone one hour of yoga practice session for three months. First ten days at the yoga camp under the supervision of yoga instructor followed by a minimum of 6 sessions per week at home. Each one hour of yoga session included yoga postures, breathing techniques and meditation. All the participants were asked to have three meals per day of low calorie (1750 to 2000 Kcal/day) vegetarian diet during the period of yoga intervention. The details of the yoga intervention are given in Table 1.

Table 1: Details about the yoga program which was repeated throughout three months.

Yoga Practice	Rounds	Duration (Minutes)
Sukhasana (Easy posture) + Prarthana mantra	1	1
Standing series of asanas		
Suryanamaskar	5	10
Ardhachakrasana	1	2
Trikonasana(Triangular pose)	1	
Supine series of Asanas		
Uttitapadasana	1	4
Vipareetakarani	1	
Naukasana	1	
Pavanamuktasana	1	
Prone series of Asanas		
Bhujangasana	1	4
Shalabasana	1	
Dhanurasana	1	
Navasana	1	
Instant relaxation Technique	1	2
Pranayama Series		
Bhastrika	36-50 strokes	3
Kapalabhati	250-300 strokes	5
Alternate nostril breathing)	20-25 rounds	6
Right nostril breathing	20-25 rounds	3
Deep Relaxation technique	-	20
Total Duration		**60 Minutes**

Statistical Analysis

Out of 112 subjects recruited for the study, 93 subjects (41 male and 52 female) completed the 75 sessions of yoga practice in three months were considered for analysis. The data obtained was verified for normal distribution and analysed using paired t-test for normally distributed data and Wilcoxon signed rank test for non-normally distributed data with SPSS (Version 20.0) package. $p<0.05$ was considered the level of significance.

Results and Discussion

Following three months of yoga practice, there was a significant decrease in body weight, BMI, waist circumference, triglycerides, total cholesterol, low density lipoprotein (LDL) and malondialdehyde while comparing the values at the end of the yoga practice with the pre values, both in case of male and female subjects.

In contrast, there was a significant increase in serum total antioxidant levels comparing the values at the end of the yoga practice with the values at the beginning both in case of male and female subjects. A significant increase in serum HDL levels was observed in case of male subjects. The groups' mean values ±S.D. are given in Table 2.

Table 2. Variables recorded at the beginning (Baseline) and end (Post) of the yoga program are provided. Values are group mean ±S.D.

Variables	Male(n=41)		Female(n=52)	
	Baseline	Post test	Baseline	Post test
Body weight (Kg)	87.11 ± 8.89	82.37±8.36**	78.36 ± 10.86	72.91±10.15**
BMI	29.91 ± 2.89	28.28 ± 2.61*	30.86±4.19	28.67±3.77*
Waist circumference (cm)	97.35 ± 5.99	94.87 ± 6.23*	87.48±6.3	84.37±5.75*
Hip circumference (cm)	107.59 ± 4.24	105.98 ± 4.08	100.44±6.36	97.99±6.41
Waist/Hip ratio	0.91± 0.04	0.89 ± 0.03	0.87±0.03	0.86±0.04
Serum Triglycerides (mg/dl)	192.03 ± 34.59	162.23 ± 28.19***	190.39±45.47	160.23±36.59**
Serum Total Cholesterol (mg/dl)	226.09 ± 31.5	191.78 ± 17.9***	212.25±45.18	180.05±30.66*
Serum VLDL (mg/dl)	23.48 ± 5.89	23.58±5.4	22.8±6.05	21.34±5.16
Serum LDL (mg/dl)	166.17±29.9	129.76±18.07**	148.73±38.34	117.2±25.66**
Serum HDL (mg/dl)	36.5±5.45	38.43±5.45*	40.74±8.76	41.51±7.87
LDL/HDL ratio	4.65±1.01	3.47±0.73	3.75±1	2.89±0.67**
Serum MDA (µ mol/L)	2.39±0.3	2.2±0.2*	2.36±0.25	2.18±0.23*
Serum TAC ((µg/ml)	148.5±17.5	182.7±24.6*	139.0±28.2	172.6±34.5**
BMI-Body Mass Index, MDA-Malondialdehyde, TAC-Total Antioxidant Capacity. Paired Student's 't' test & Wilcoxon-signed rank test comparing baseline & Post assessment values; * p <0.05, ** p <0.01, *** p <0.001.				

The results of the study reveal that three months of yoga practice has significantly improved body weight, BMI, lipid profile and oxidative stress markers in both male and female subjects with obesity. The result of the present study shows significant reduction in body weight. It has been stressed that weight loss is the key contributor towards correction of dyslipidemia (Diaz *et al,* 2006), especially by reduction in visceral fat (Larson-Meyer *et al,* 2006). The significant

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reduction in the body weight and BMI as recorded in the present study are in line with the earlier studies, wherein, a 6-day yoga program led to decreased body mass index (BMI), waist and hip circumference, total cholesterol, (Telles *et al* 2010) and one month yoga program led to decreased body weight and BMI (Suchetha *et al* 2011). There was also a significant decrease in the waist circumference and the hip circumference. However, there was no change in waist/hip circumference ratio, suggesting that there was no change in the ratio between fat stored centrally inside the abdomen (waist circumference) and fat stored peripherally (hip circumference).

The decrease in total cholesterol, LDL cholesterol, and triglycerides suggest that yoga may reduce the risk of cardiovascular diseases associated with dyslipidemia (Ebong *et al,* 2013). Similar results were reported by another study, wherein, there was a significant improvement in all the variables of lipid profile after the yoga intervention (Gokal *et al,* 2007). Moreover, results of the present study indicate an increase in the level of HDL after three months of yoga practice.

Accumulation of oxidative stress in adipose tissue is one of the early events in the development of metabolic syndrome in obesity (Prasad *et al,* 2012). On the other hand, weight loss by calorie restriction and/or exercise can ameliorate the state of oxidative stress (Bigornia et al, 2010). Regular exercise has been shown to improve antioxidant status in both animal and human studies (Kim *et al,* 1996; Gordon *et al,* 2008). In the present investigation, we observed a significant reduction in serum MDA level, an indicator of oxidative stress by yoga practice, which is nearly similar to the findings of earlier studies done with obesity and type 2 diabetic subjects (Gordon *et a*l 2008; Hegde *et al,* 2011). Yoga training in obese individuals has shown improvement in the serum total antioxidant capacity in the present study. An earlier study also reported that yoga practice stimulates the expression of antioxidant enzymes, mediated by the activation of redox-sensitive signalling pathways (Reid, 2001). These results suggest regular practice of yoga by the subjects with obesity would be very useful to normalise the metabolic parameters.

Conclusion

The findings of the study suggest that yoga can be used as an effective life-style modality to reduce the body weight and to produce significant improvement in anthropometric parameters, lipid profile and to reduce oxidative stress and to enhance antioxidant defence in patients of obesity. Yoga-based lifestyle intervention for body weight and stress, and thereby leading to a reduction in inflammation, can effectively prevent and retard the progression of cardiovascular and metabolic disorders because the chronic elevation of inflammatory mediators leads to cardiovascular morbidity and mortality.

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Conflict of interest: None declared.

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