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Effects of yoga training on body composition, cardiovascular and biochemical parameters in healthy adult male volunteers

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Abstract: *Introduction:* Physical inactivity and stressful condition reduces the fitness level which may lead to cardiovascular diseases (CVD). *Objectives:* To study the effects of yoga on body composition, cardiovascular parameters and lipid profile on healthy adult males. *Methods:* A total of 60 healthy male volunteers within the age group of 18-24 years were included and were divided into two groups: (a) Control Group (N=30) and Experimental Group (N=30). Yoga training was given for 60 min per day, 06 days per week for 12 weeks in the experimental group. In the control group no yoga training was given. Assessment of body composition, cardio-respiratory fitness and lipid profile were performed in both the groups before yoga training (0 week) and after the training (12 weeks). *Results:* Significant reduction ($P<0.05$) in percentage of body fat, systolic blood pressure, resting heart rate, total cholesterol (TC), triglyceride (TG) and low density lipoprotein cholesterol (LDL-C) levels were noted among the experimental group after 12 weeks of yoga training when compared to baseline data (0 week). On the other hand, significant increase ($P<0.05$) in high density lipoprotein cholesterol (HDL-C) was noted in the experimental group after 12 weeks of yoga training when compared to baseline data (0 week). *Conclusions:* These changes might be due to yoga training. Regular yoga practice improves body composition and cardiovascular status and maintains lipid profile.

Keywords: Yoga, Body Fat, Blood Pressure, Lipid Profile.

Introduction

Work related stress can have numerous path physiological effects on the body system [1-3]. Physical activity conveys multiple health benefits including decreased rates of coronary artery disease, hypertension, non-insulin dependent diabetes mellitus, osteoporosis, colon cancer, anxiety and depression, as well as decreased risk of overall mortality [4].

Physical inactivity leads to obesity and abnormal lipid profile. It has been seen that lipid abnormalities significantly contribute to the increased risk of cardiovascular disease (CVD) [5]. There is growing evidence showing that hyperglycaemia and dyslipidaemia are linked to increased cardiovascular risk [6]. It has been demonstrated that high levels of serum TC, triglycerides, LDL, VLDL, hypertension, low levels of HDL and increased body mass index (BMI) are significantly associated with cardiovascular heart disease (CVD) [7]. Yoga, with origins in ancient India has several sub-types, and incorporates physical postures (asanas), controlled breathing (pranayama), deep relaxation, and meditation. Regular practice of yoga enhances fitness and co-ordination to brain and muscular activities [8]. The stressful conditions and physical inactivity may lead to various diseases. Thus reducing the number of working days, productivity and enhance the expenditure towards medication. These impose a huge burden on the employers and the country at large. On the basis of the above, the present study was designed to find out the effects of yoga on body composition, cardiovascular parameters and lipid profile in healthy adult male.

Material and Methods

Subject and Experimental Design: For the present study a total of sixty (60) healthy male volunteers within the age group of 18-24 years were included randomly from the Midnapore District West Bengal, India. All the volunteers went through a medical examination performed by Physicians. The volunteers were

randomly divided into two groups: (a) Control Group (N=30) and Experimental Group (N=30).

Yoga training was provided in the experimental group, where as in the control group there was no yoga training. Yoga training was given by qualified yoga instructor for 60 min per day, 06 days per week for 12 weeks duration following a standard protocol [9]. The detail of yoga protocol is presented in table 1. Assessment of body composition, cardiovascular, lipid profile and oxidant-antioxidant defence mechanism was estimated among the groups. All the parameters were recorded at baseline, before yoga training (0 week) and after (12 weeks) of the training. The volunteers were informed about the purpose and the possible complications of the study, and written consents were taken from them. The volunteers were asked to refrain from smoking and alcohol throughout the experiment. The subjects were asked to maintain their normal diet. The experimental protocol was approved by the Institutional Ethical Committee.

Table-1: Contents of yogic package practiced by the volunteers during the training schedule

Yogic Training Schedule	Duration of each session (min)
Prayer	02
Om chanting	02
Gayatri Mantra	02
Yogic SukshmVyayam	10
Surya Namaskar	12
Yogasana (i) Shavasana (ii) Supt Pawan Muktasana (iii) Kandrasana (iv) Makarasana (v) Shalabhasana (vi) Bhujangasana (vii) Mandukasana (viii) Usharasana (ix) Gomukhasana	10
Pranayama (i) Kapal Bhati (ii) Mahabandh (iii) Laybadh Shvas Prashwas (iv) Nadi Shodhan (v) Ujjayi & Bhramari Pranaya	15
Meditation	05
(i) Ajpa Jap (ii) Shanti Mantra	02
Total	60

Measurements:

Assessment of body composition: The height (stature) was measured by the stadiometer (Seca 220, UK) having accuracy recorded to the nearest 0.5 centimetres (cm) [10]. The body mass of the subject was taken on a standard electronic weighing machine (Seca Alpha 770, UK), having accuracy recorded to the nearest 50 grams (gm). The body mass was recorded in kilograms [10]. Body mass index (BMI) and Body surface area (BSA) were derived from the standard equation using body mass and stature [10].

A skin fold calliper (Holtain Limited, UK) was used to assess the body fat percentage following standard methodology [11]. Body density was calculated by the standard formulae [12]. The skin fold thickness at the site of biceps, triceps, sub-scapular and suprailiac was used to calculate the body density. Computation of percent body fat, fat mass and lean body mass (LBM) were derived using the standard equation [11].

Assessment of cardiovascular parameters: The subject was asked to take rest for 15 minutes, the heart rate and blood pressure was recorded using standard procedure [13].

Estimation of lipid profile: A 5 ml of venous blood was drawn from an antecubital vein after a 12-hour fast and 24 hours after the last yoga exercise for the subsequent determination of selected biochemical parameters. For estimation of lipid profile serum triglycerides [14], serum total cholesterol (TC) [15] and high-density lipoprotein cholesterol (HDL-C) [15] were determined by enzymatic method. Low-density lipoprotein cholesterol (LDL-C) was indirectly assessed following standard equation [16].

Statistical Analysis: All the data of were expressed as mean and standard deviation (SD). Repeated measures Analysis of Variance (ANOVA) followed by multiple comparison (Post Hoc) tests were performed to find out the significant difference in intra group and inter group variables. In each case the significant level was chosen at 0.05 levels.

Results

Effect of yoga on body composition variables: The body composition variables showed that there was significant reduction (P<0.05) in percentage of body fat as well as total fat mass in the experimental group after 12 weeks of yoga training when compared to baseline data. However, there was no significant difference in height, body mass, BMI, BSA and LBM among the experimental group after 12 weeks of yoga training when compared to baseline data (0 week). In the control group no such changes were noticed after 12 weeks of study. Further, the control group had significantly (P<0.05) higher body mass, BMI and body fat when compared to experimental group (Table 2).

Table-2: Body composition characteristics of yoga and control group subjects

Groups	Control Group		Experimental Group	
Parameters	**0 Week**	**12 Weeks**	**0 Week**	**12 Weeks**
Height (cm)	169.3 ± 4.1	169.3^{NS} ± 4.1	171.1 ± 6.8	171.1^{NS} ± 6.8
Body mass (kg)	64.4 ± 4.0	64.8^{NS} ± 5.1	$60.1^{\#}$ ± 5.4	$58.7^{\#}$ ± 6.2
BMI (kg m^{-2})	22.5 ± 1.2	22.8^{NS} ± 1.6	$20.5^{\#}$ ± 1.7	$20.1^{\#}$ ± 1.2
BSA (m^2)	1.7 ± 0.1	1.7^{NS} ± 0.1	1.7^{NS} ± 0.1	1.7^{NS} ± 0.1
Fat (%)	15.8 ± 2.6	14.7^{NS} ± 2.3	$14.1^{\#}$ ± 1.7	$10.4^{*\#}$ ± 1.5
Fat mass (kg)	9.6 ± 1.6	9.2^{NS} ± 1.4	$7.9^{\#}$ ± 1.2	$6.4^{*\#}$ ± 1.2
LBM (kg)	54.8 ± 3.9	55.9 ± 4.3	53.4^{NS} ± 5.0	51.7^{NS} ± 4.6

P<0.05, * when compared to baseline data (0 week), # when compared to control group, NS= not significant, BMI= body mass index, BSA= body surface area, LBM= lean body mass.

Effect of yoga on cardiovascular variables: It has been seen that there was significant reduction (P<0.05) in systolic blood pressure and resting heart rate in the experimental group after 12 weeks of yoga training when compared to baseline data. However, there was no significant change in diastolic blood pressure among the experimental group after 12 weeks of yoga training when compared to baseline data (0 week). In the control group no such changes were noticed after 12 weeks of study. Further the experimental group had significantly (P<0.05) lower systolic blood pressure, resting heart rate and respiratory rate when compared to control group at the end of 12 weeks (Table 3).

Table-3: Blood pressure and heart rate response of yoga and control group subjects

Groups	Control Group		Experimental Group	
Parameters	**0 Week**	**12 Weeks**	**0 Week**	**12 Weeks**
SBP (mmHg)	122.4 ± 5.42	122.6^{NS} ± 4.12	122.1^{NS} ± 4.18	$118.3^{*\#}$ ± 3.37
DBP (mmHg)	79.8 ± 6.44	80.2^{NS} ± 5.31	78.6^{NS} ± 4.12	78.2^{NS} ± 4.25
Resting HR (beats/min)	81.7 ± 7.4	80.1 ± 6.5	79.8^{NS} ± 5.3	$75.4^{*\#}$ ± 4.1

P<0.05, * when compared to baseline data, # when compared to control group, NS= not significant, SBP= systolic blood pressure, DBP= diastolic blood pressure, HR= heart rate.

Effect of yoga on lipid profile: The lipid profile showed that, there was significant reduction (P<0.05) in total cholesterol (TC), triglyceride (TG) and low density lipoprotein cholesterol (LDL-C) among the experimental group after 12 weeks of yoga training when compared to baseline data (0 week). On the other hand, there was significant increase (P<0.05) in high density lipoprotein cholesterol (HDL-C) among the experimental group after 12 weeks of yoga training when compared to baseline data (0 week). In the control group no such changes were noticed after 12 weeks of study. Further, the experimental group had

significantly (P<0.05) lower total cholesterol (TC), triglyceride (TG) and low density lipoprotein cholesterol (LDL-C); and significantly higher (P<0.05) high density lipoprotein cholesterol (HDL-C) when compared to control group at the end of 12 weeks (Table 4).

Table-4: Lipids and lipoprotein profiles of yoga and control group subjects

Groups	Control Group		Experimental Group	
Parameters	**0 Week**	**12 Weeks**	**0 Week**	**12 Weeks**
TC (mg/dl)	166.6 ± 10.9	169.5^{NS} ± 8.6	164.3^{NS} ± 10.2	$149.7^{*\#}$ ± 9.8
TG (mg/dl)	98.2 ± 9.1	100.5^{NS} ± 7.3	97.3^{NS} ± 8.6	$83.0^{*\#}$ ± 5.3
HDL-C (mg/dl)	39.4 ± 5.1	40.6^{NS} ± 4.8	41.2^{NS} ± 4.7	$44.8^{*\#}$ ± 4.2
LDL-C (mg/dl)	97.8 ± 9.6	95.7^{NS} ± 10.5	94.9^{NS} ± 8.6	$86.0^{*\#}$ ± 9.2

P<0.05, * when compared to baseline data, # when compared to control group, NS= not significant, TC= total cholesterol, TG= triglyceride, HDL-C= high density lipoprotein cholesterol, LDL-C= low density lipoprotein cholesterol.

Discussion

Yoga has a role in maintaining good health and physical fitness. In the present study, significant reduction in body fat was noted after 12 week of yoga exercise. The reduction in body fat might be due to the fact that the volunteers underwent a high level of yogic exercise over a period of time, which resulted in lowering of body fat percentage. Yoga involves deep nostril breathing, flexibility of limbs and stretching of different body parts, which might be the cause of reduction of body fat of the volunteers practicing yoga. Similar observations were noted by many authors where reduction in body fat was noted after yoga training [3].

Another study conducted by Zorofi et al., [17] has reported significant reduction of body fat after yoga training. On the other hand, no significant difference was observed in body mass and LBM among the subjects after the training programme. This might be due to improper optimization of the training load and/or short duration of the training. Increase in body fat can elevate the risk factors for obesity, cardiovascular disease, diabetes and many other complications [3]. Regular yoga practice may reduce body fat, which is essential to maintain disease free lifestyle.

Heart rate and blood pressure are essential for assessing cardiovascular fitness. The cardiovascular response in yoga was studied in the present experiment and it has been seen that there was significant reduction in systolic blood pressure and resting heart rate among the experimental group after 12 weeks of yoga training when compared to baseline data. However, there was no significant change in diastolic blood pressure among the experimental group after yoga training. Similar observations were noted by many authors where reduction in blood pressure and heart rate was noted after yoga training [18]. Reduction in heart rate and blood pressure indicate a shift in the balancing components of autonomic nervous system towards the parasympathetic activity [19-20].

This modulation of autonomic nervous system activity might have been brought about through the conditioning effect of yoga on autonomic functions and mediated through the limbic system and higher areas of central nervous system [21]. Regular practice of yoga increases the baroreflex sensitivity and decreases the sympathetic tone; thereby restoring blood pressure to normal level in patients of essential hypertension [22].

Meditation by modifying the state of anxiety reduces stress - induced sympathetic over activity thereby decreasing arterial tone and peripheral resistance, and resulting in decreased diastolic blood pressure and heart rate, this ensures better peripheral circulation [23] and blood flow to the tissues [24]. Heart rate and blood pressure are essential components for cardiovascular fitness. Elevation in these variables is the risk factors for cardiovascular disease, and many other

complications. Regular yoga practice may reduce heart rate and blood pressure which are essential to maintain disease free lifestyle.

Lipids and lipoprotein profile indicate the cardiovascular and the metabolic status of the subject [25-26]. Lipoprotein abnormalities play an important role in the causation of atherosclerosis [27]. Dyslipidaemia causes morbidity and mortality with elevated triglyceride and LDL-C, and decreased HDL-C concentrations [28]. In the present study, significant reduction in total cholesterol (TC), triglyceride (TG) and low density lipoprotein cholesterol (LDL-C); significant elevation in high density lipoprotein cholesterol (HDL-C) were noted among the experimental group after 12 weeks of yoga training when compared to baseline data. These changes might be due to yoga training. The possible reason for the reduction in triglyceride and LDL-C; and elevation in HDL-C was that yoga exercise especially, deep breathing, stretching and flexibility exercise which increased metabolism and utilization of blood lipids and lipoprotein for energy production [25-26].

Our findings are in conformity with the observations of other researchers in their recent studies. Cross-sectional studies also reported an increase in HDL-C level and decrease in triglyceride level after yoga exercise [29]. Agrawal et al. [30] reported significant improvement in glycaemic control and lipid profile in type 2 diabetic patients exposed to yoga exercise where there was significant reduction in serum TC, triglyceride and LDL concentrations associated with concomitant significant increase in HDL concentrations after three months. It can be suggested that lipids and lipoprotein profile are essential for assessment of cardiovascular and the metabolic status of the subject. Elevation in TC, TG and LDL-C and reduction in HDL-C level is the risk factors for atherosclerosis, and many other complications. Regular yoga practice may reduce TC, TG and LDL-C and elevate HDL-C, thus reducing the risk of atherosclerosis and coronary artery disease, which are essential to maintain disease free lifestyle.

Conclusions

Regular yoga practice helps to maintain normal healthy life style and physical fitness which is indicated by decreasing body fat, blood pressure, heart rate and maintaining lipid profile. The findings of this study demonstrate the efficacy of yoga exercise on body composition, cardiovascular variables and lipid profile in healthy subjects. It can be said that yoga can be used as an effective life-style modality to reduce the chance of CVD. Thus regular practice of yoga may be helpful to reduce stress and maintain disease free lifestyle. As young people are the working force of the country, thus regular practice of yoga may increase the number of working days, productivity and reduce the expenditure towards medication by maintaining the disease free lifestyle.

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