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Original Article

Effects of a yoga intervention on lipid profiles of diabetes patients with dyslipidemia

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ABSTRACT

Objective: The present study was conducted to assess the effectiveness of yoga in the management of dyslipidemia in patients of type 2 diabetes mellitus.

Methods: This randomized parallel study was carried out in Medical College Trivandrum, Kerala, India. Hundred type 2 diabetics with dyslipidemia were randomized into control and yoga groups. The control group was prescribed oral hypoglycemic drugs. The yoga group practiced yoga daily for 1 h duration along with oral hypoglycemic drugs for 3 months. The lipid profiles of both the groups were compared at the start and at the end of 3 months.

Results: After intervention with yoga for a period of 3 months the study group showed a decrease in total cholesterol, triglycerides and LDL, with an improvement in HDL.

Conclusion: Yoga, being a lifestyle incorporating exercise and stress management training, targets the elevated lipid levels in patients with diabetes through integrated approaches.

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1. Introduction

The major risk factor for cardiovascular disease in diabetes mellitus is dyslipidemia.¹ The characteristic features of diabetic dyslipidemia are a high plasma triglyceride concentration, low high-density lipoprotein (HDL) concentration and increased concentration of small dense low-density lipoprotein (LDL) particles. Insulin resistance leads to increased flux of free fatty acids and hence the lipid changes.² Reports from the National Health and Nutrition Examination Survey (NHANES) 1999–2000 indicate that 55% of the U.S. general population and 51% of adults aged 20–59 years with diabetes have hypercholesterolemia.^{3,4}

Caloric restriction and weight loss for the overweight individual with diabetes mellitus have been of proven

therapeutic value. However, there is no consensus on the ideal dietary composition for these patients. Genetic factors and the lipid phenotype of the individual determine the way the plasma lipid profiles change in these patients.⁵ Lifestyle changes, including increased physical activity and dietary modifications have, however, been the cornerstones of management of dyslipidemia in diabetes.⁶

Mahajan conducted a study on subjects with mild to moderate hypertension and reported that yoga can play an important role in risk modification for cardiovascular diseases.⁷ Another study had reported a better lipid profile in long and medium term meditators when compared to non-meditators.⁸ In view of these observations, the present study was undertaken to assess the effect of yoga practice on the lipid profile in patients with type 2 diabetes mellitus (DM).

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2. Materials and methods

2.1. Setting

Patients reporting to the out-patient department of Holistic Medicine and in the Diabetic clinic, Medical College Trivandrum, Kerala, India, in the year 2005 were the participants of this randomized parallel study. The Holistic Medicine department aims at bringing lifestyle modifications in patients with non-communicable diseases and also offers regular yoga classes for all the patients in its care. The study was conducted after the approval of the Ethics Committee of the Medical faculty and all subjects volunteered for the trial.

2.2. Study sample

The guidelines of the National Diabetes Data Group and the third set of the Adult Treatment Panel of the National Cholesterol Education Program (NCEP ATP III) were used to recruit one hundred patients with type 2 diabetes and dyslipidemia.^{9,10} Known diabetic patients who were on treatment with sulphonylureas were included in the study. Patients who are smokers, alcoholics, pregnant, on long-term steroids and those with known retinopathy, nephropathy, coronary artery disease and cerebrovascular diseases were excluded from the study.

One hundred patients with type 2 DM attending the Diabetic clinic were randomized into control group of 27 males and 23 females and experimental group of 24 males and 26 females. The experimental group was prescribed oral hypoglycemic drugs and in addition followed lifestyle modification in the form of 1 h daily practice of yoga for a period of 3 months at the Holistic Medicine department. The control group was prescribed oral hypoglycemic drugs only and did not perform yogic exercises during this period.

2.3. Methodology

Detailed history of the patients including age, gender, and disease history including duration and complications, treatment details including drug, dosage and duration of treatment were noted in the questionnaire. Body weight and height were measured using standard protocols with participants wearing light clothing without shoes. Body mass index (BMI) was calculated. Waist and hip circumferences were measured. The patients were advised to come fasting overnight and 5 ml blood samples were withdrawn from each patient under all aseptic conditions and collected in plain bottles. The fasting blood samples were analyzed for triglycerides (TG), total cholesterol (TC) and high-density lipoprotein-cholesterol (HDL-C). Cholesterol were estimated by modified Roeschlav's method¹¹ and Triacylglycerol by the method of Wako modified by Mc Gowan et al.¹² HDL cholesterol was assessed by phosphotungstic acid method.¹³ LDL cholesterol was not separately estimated but calculated from the formula: LDL cholesterol = Total cholesterol – [HDL cholesterol + TG/5].

Yoga classes were conducted by an experienced yoga teacher who chose the asanas in the package and adapted their execution to the needs and abilities of the participants.

The experimental group was taught a series of yoga postures in groups of 25 patients each. They were instructed to practise them daily for 1 h duration and were asked to record the number of minutes they engaged in yoga per day. Yoga treatment consisted of practice of 1) asanas (Body postures), 2) pranayama (Breathing exercises) and 3) meditation techniques (Table 1), to be practiced for 1 h duration. At the end of 2 weeks of supervised yogic training each subject was given advice on ongoing medical treatment and was given a booklet illustrating personalized yoga program to practice regularly at home. All subjects were required to contact the Holistic Medicine department once every month for follow up advice. The control group was asked to report to Diabetic clinic every month for their follow up after being given advice on ongoing medical treatment at the start of the study. There were no alterations made in the treatment and dietary habits of either group during the study period. Both the groups were advised to continue with their carbohydrate restricted fiber rich diet.

The BMI, W/H circumference and lipid profile of all the participants were measured at the end of 3 months. Data were entered in Microsoft Excel and SPSS Version 12 was used for analysis. Paired and unpaired t tests were employed to compare measures. A p value of <0.05 as significant and a p value of <0.01 was considered highly significant.

3. Results

A total of 100 type 2 diabetic patients, 52 males and 48 females of mean age 45 years participated in the study. The average duration of diabetes in the participants was 5–10 years. Both the groups were similar in respect to mean age, sex, weight, BMI, W/H ratio, glycemic control, Serum triglycerides and HDL levels. The total cholesterol and LDL levels were, however, significantly higher in the experimental group compared to control group (Table 2).

Table 1 – Yoga practices specified for diabetic patients.

Asanas (body postures)	30–35 min
Suryanamaskaram (sun salutation)	5 min
Yoga Mudrasana (psychic union pose)	2 min
Vajrasana (thunderbolt pose)	2 min
Vakrasana (twisted pose)	2 min
Paschimottasana (seated forward bend)	2 min
Pavanamuktasana (wind relieving pose)	2 min
Sashankasana (hare pose)	2 min
Ushtrasana (camel pose)	2 min
Bhujangasan (cobra pose)	2 min
Dhanurasana (bow pose)	2 min
Arthakatchakrasana (lateral arc pose)	2 min
Parivatha trilokasanaan (revolved triangle pose)	2 min
Shavasana (corpse pose)	5 min
Pranayama (breathing exercises)	10 min
Ujjayi pranayama	5 repeats
Anuloma viloma	10–15 repeats
Alternate Kapalapathi pranayama	5 repeats
Suryabhedha pranayama	5 repeats
Meditation	15 min
One-one meditation	5 min
Breath counting meditation	5 min
Thought counting meditation	5 min

Table 2 – Baseline characteristics of the participants.

Parameters	Control group	Study group
	(Medication only) n = 50	(Medication + Yogic intervention) n = 50
Mean age (years)	44.46 ± 10.98	45.51 ± 7.98
Sex (M/F)	23 F, 27 M	26 F, 24 M
Wt (kg)	62.20 ± 4.45	62.17 ± 4.67
BMI (kg/m ²)	23.2 ± 2.14	22.9 ± 2.15
W/H ratio	0.93 + 0.07	0.94 + 0.07
FBS (mg/dl)	181.57 ± 66.25	155.86 ± 60.53
PPBS (mg/dl)	265.31 ± 74.70	240.31 ± 79.42
Total cholesterol (mg/dl)	225.74 ± 37.60	244.86 ± 28.09*
Triglyceride (mg/dl)	172.74 ± 52.55	151.89 ± 43.08
LDL cholesterol (mg/dl)	126.11 ± 30.41	144.74 ± 28.46*
HDL cholesterol (mg/dl)	44.23 ± 5.21	44.63 ± 9.35

*p < 0.05.

The study showed that 3 months of yoga practice resulted in a non-significant decrease in BMI from 25.12 ± 1.54 to 23.59 ± 1.38 kg/m². A significant decrease in the weight from 62.20 ± 4.45 to 59.60 ± 4.65 kg and W/H ratio from 0.94 + 0.07 to 0.89 + 0.07 was recorded.

There was a significant reduction in total cholesterol, triglycerides and LDL cholesterol. Mean total cholesterol before yoga was 244.86 ± 28.09 mg% and was reduced to a mean of 219.56 ± 32.02 mg%. Triglycerides showed a significant reduction from 151.88 ± 43.08 mg% to 130.11 ± 28.82 mg% while the LDL reduced from 144.74 ± 28.45 to 120.51 ± 34.31 mg%. There was a non-significant elevation in HDL from 44.63 ± 9.35 mg% to 47.15 ± 8.17 mg% (Table 3).

After a period of 3 months the control group showed a significant increase in body weight, non-significant increase in BMI, total cholesterol, triglycerides and LDL and a decrease in HDL (Table 4).

4. Discussion

The present study was aimed at studying the effect of practicing yoga in patients with type 2 DM for 3 months. The practice of yoga in these patients resulted in a decrease in BMI, body weight, W/H ratio, total cholesterol, triglycerides and LDL cholesterol and an increase in HDL.

Table 3 – Comparison of pre-yoga and post-yoga values in experimental group.

Parameters n = 50	Pre-yoga (mean ± SD)	Post-yoga (mean ± SD)
WT(kg)	62.20 ± 4.45	59.60 ± 4.65*
BMI (kg/m ²)	25.12 ± 1.54	23.59 ± 1.38
W/H ratio	0.94 + 0.07	0.89 + 0.07*
Total cholesterol (mg/dl)	244.86 ± 28.09	219.54 ± 32.02**
Triglycerides (mg/dl)	151.88 ± 43.08	130.11 ± 28.82*
LDL cholesterol (mg/dl)	144.74 ± 28.45	120.51 ± 34.31**
HDL cholesterol (mg/dl)	44.63 ± 9.35	47.15 ± 8.17

*p < 0.05, **p < 0.01.

Table 4 – Comparison of initial values of parameters and follow up values of the control group.

Parameters n = 50	Initial value (mean ± SD)	Follow up (mean ± SD)
WT (kg)	62.17 ± 4.67	63.03 ± 5.10*
BMI (kg/m ²)	24.73 ± 1.87	25.03 ± 2.14
W/H ratio	0.93 + 0.07	0.91 + 0.05
Total cholesterol (mg/dl)	225.74 ± 37.60	235.23 ± 26.64
Triglycerides (mg/dl)	172.74 ± 52.55	197.91 ± 130.11
LDL cholesterol (mg/dl)	126.11 ± 30.41	126.60 ± 22.84
HDL cholesterol (mg/dl)	44.23 ± 5.21	43.13 ± 12.33

*p < 0.05.

Improving glycemic control has not yet been shown to prevent development of macro-vascular complications in type 2 DM. Alternately, carefully controlled treatment measures with exercise, dietary modification and oral drugs can be expected to improve diabetic lipid disorder.¹⁴

The effect of exercise on blood lipid profiles has been widely reported.^{15,16} Physical activity raises HDL levels and decreases the concentration of very low-density lipoprotein cholesterol and triglycerides.¹⁷ Physical activity and HDL appear to be linked via HDL's role in triglyceride metabolism.¹⁸

It is, however, seen that diabetic patients usually cannot sustain the levels of recommended physical activity for them due to varied reasons like age, obesity, cardiovascular disease and other complications. Compliance and motivation for performing activity at 50–70% of maximum aerobic capacity regularly is quite poor.¹⁹

Yoga has a beneficial effect on insulin kinetics and the lipid profile resulting from it. A decrease in waist hip ratio in this study is consistent with that reported by Sahay et al, who also reported an associated increase in lean body mass and reduction in skin fold thickness. Yoga helps in redistribution of body fat and reduction in central obesity which leads to insulin resistance. A decrease in insulin resistance, increase in insulin receptors and sensitivity, shift of peak level of insulin to left with normalization of insulin glucagon ratio was also reported.²⁰

The dynamic stretching of the body during yoga asanas is postulated to rejuvenate pancreatic cells, increase insulin secretion and hence correct the impaired insulin secretion in chronic diabetes.²¹

Various studies have reported physical, physiological, psychological and endocrinological changes with the practice of yoga. Manchanda and Narang found that after one year of yoga therapy, patients with coronary artery disease (CAD) showed significant reduction in serum total cholesterol, triglycerides and LDL cholesterol. The patients showed a significant reduction in the number of angina episodes and required revascularization procedures less frequently. Angiography after one year showed regression of lesions.²² The practice of Raja yoga meditation was found to lower serum cholesterol by Vyas,²³ while Sahay²⁰ and Bijlani²⁴ noted that yoga practice causes significant reduction in free fatty acids, LDL, VLDL and an increase in HDL.

The beneficial effect of yoga in the management of hyperlipidemia and obesity cannot just be attributed alone to the simple excess calorie expenditure as there is no rapid muscle activity and energy generation involved in yoga.

Repeated stress is known to lead to persistent elevation of cortisol which causes central obesity and insulin resistance.²⁵ It increases gluconeogenesis and diminishes peripheral uptake of glucose.²⁶ Decreased glucose uptake and insulin secretion can also occur due to stress induced release of growth hormone and β endorphin.²⁷ Elevated cortisol is also linked to dyslipidemia, and higher blood pressure.²⁸ Yoga has been reported to lower levels of sympathetic hormones and reduce cortisol. Pranayama reduces sympathetic tone, increases parasympathetic activity and also helps an individual reduce stress.^{8,29,30} Meditation also brings about a hypometabolic state and reduces stress induced sympathetic over activity.³¹ Better ability to overcome stress resulting in lowered cortisol levels can be cited as possible mechanism for improvement in lipid profile in patients practicing yoga.

Dyslipidemia is usually associated with the abnormalities in lipolysis; triglyceride metabolism and free fatty acid turn over in a case of insulin resistance. Impaired lipoprotein lipase and increased hepatic lipase activity is thought to be a resulting from insulin resistance in diabetes. Chronic exposure to elevated free fatty acids have been associated with impaired insulin secretion.³² The improvement in lipid profile with practice of yoga could be due to increased hepatic lipase and lipoprotein lipase. This would increase the uptake of triglycerides by adipose tissue and affect the lipoprotein metabolism.³³

Yoga practice is also proved to affect mental balance of an individual allaying apprehension, stress and bringing about hormonal balance and feelings of well being. This sense of well being is attributed to its ability to increase endogenous melatonin secretion.³⁴ This can explain the probability of greater compliance with its practice even in long-term and its use as an effective intervention in control of the disease.

5. Conclusion

The present study has shown an efficacy of improving the dyslipidemic state associated with diabetes. Yoga, being a lifestyle incorporating exercise and stress management training, targets the elevated lipid through integrated approaches resulting in improved lipid profiles, lower BMI, and macro-vascular complications in diabetes.

5.1. Strength of study

The yoga package was designed after extensive literature review by yoga specialists and was a perfect combination of asana and breathing exercises targeted at the disease under study. Excellent compliance of study sample and there were no drop outs. Experimental group patients voluntarily reported to Holistic medicine department and were self motivated for the practice of yoga. The control group was also under constant surveillance by the Diabetic care clinic.

5.2. Limitations of the study

Direct supervision of the patients was not possible for the entire period of the study. Dietary data were not recorded.

Long-term study was not possible due to threat of non-compliance of the patients.

Conflicts of interest

All authors have none to declare.

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