




## Research Article

## Role of Yoga on Lipid Profile in Diabetes Mellitus

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## Abstract

**Introduction:** Type 2 diabetes mellitus (T2DM) is a public health problem and is often accompanied by dyslipidemia, which represents a major risk factor for cardiovascular diseases. Lifestyle modification is a part of diabetes management, and yoga has been found to be beneficial in influencing metabolic and psychological health. The present study aimed to assess the effect of yoga on lipid profile and quality of life in T2DM patients.

**Materials and Methods:** This is a prospective interventional study of 100 patients with T2DM who visited a tertiary care teaching hospital. The participants were split into two groups of 50 people. Group A underwent structured yoga therapy along with the standard medical treatment and Group B underwent standard treatment only. Yoga program was followed for 6 months. Fasting blood sugar (FBS), postprandial blood sugar (PPBS), glycated haemoglobin (HbA1c), lipid profile parameters, and quality-of-life scores were measured at baseline, 3 months, and 6 months. The data were analysed using SPSS version 27.0 and a p-value of <0.05 was used to determine significance.

**Results:** The baseline characteristics were similar in both groups. At 6 months, Group A showed significantly greater improvements in glycemic parameters, including FBS ( $120.52 \pm 9.12$  vs.  $125.72 \pm 7.06$  mg/dL;  $p=0.002$ ), PPBS ( $181.30 \pm 11.28$  vs.  $186.74 \pm 5.49$  mg/dL;  $p=0.003$ ), and HbA1c ( $6.68 \pm 0.41\%$  vs.  $7.00 \pm 0.70\%$ ;  $p=0.007$ ). Significant improvements in lipid profile were also observed in the yoga group, with lower total cholesterol ( $184.12 \pm 15.30$  vs.  $196.76 \pm 7.66$  mg/dL), LDL cholesterol ( $123.92 \pm 14.00$  vs.  $130.80 \pm 5.46$  mg/dL), triglycerides ( $142.46 \pm 13.41$  vs.  $154.34 \pm 5.54$  mg/dL), and higher HDL cholesterol ( $47.70 \pm 7.40$  vs.  $41.96 \pm 5.81$  mg/dL) compared with controls (all  $p<0.01$ ). Quality-of-life scores improved significantly in the yoga group ( $64.02 \pm 4.80$  vs.  $60.42 \pm 6.51$ ;  $p=0.002$ ).

**Conclusion:** Yoga as an adjunct to standard treatment has a significant positive effect on glycemic control, lipid profile and quality of life in patients with T2DM. It is low-cost, safe, and readily available and thus can be a valuable adjunct in overall diabetes care.

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**KEYWORDS:** Type 2 diabetes mellitus, Yoga, Lipid profile, Glycemic control, Quality of life.

## 1. INTRODUCTION

Diabetes mellitus (DM) is one of the most important health problems in the world and is one of the most important causes of morbidity and mortality worldwide [1]. Diabetes is an ever-increasing disease, especially in the developing countries like India, where a significant proportion of disease burden is associated with diabetes [2]. Diabetes is also accompanied by a number of metabolic abnormalities that play a major role in the long-term complications besides chronic hyperglycaemia [3]. Of those, dyslipidemia is one of the most important risk factors for cardiovascular disease and is the primary cause of death in people with type 2 diabetes mellitus (T2DM) [4]. Diabetic dyslipidemia is usually manifested by the presence of hypertriglyceridemia, hyper-LDL cholesterol and hypo-HDL cholesterol, which leads to a higher cardiovascular risk and acceleration of atherosclerosis [5].

In addition to good glycemic control, correction of lipid abnormalities is required for optimal management of diabetes. Although pharmacological treatment, including statins and antidiabetic drugs, are effective, long-term disease control is often hampered by poor adherence, side effects and cost [6,7]. Thus, lifestyle modification has become a key part of the diabetes management [8]. It has been demonstrated that regular exercise, diet control and weight loss all help to improve glycemic state and lipid metabolism [9]. But, for many patients especially older adults and patients with obesity and physical restrictions, it can be hard to keep up with traditional exercise routines.

Yoga is an ancient mind-body practice, which incorporates physical postures (asana), breathing techniques (pranayama), and relaxation or meditation [10]. Yoga has become a popular complementary therapy for chronic metabolic diseases over the last few years [11]. There are indications that yoga leads to an increase in autonomic balance, a decrease in sympathetic overactivity, a decrease in stress hormone levels and an increase in insulin sensitivity [12]. These physiological effects can lead to better glucose utilization, better lipid metabolism and a decrease in cardiovascular risk factors. Yoga has been shown to have beneficial effects on serum lipid profile, glycemic control, body weight, oxidative stress and overall well-being of patients with diabetes and other metabolic disorders [13,14].

Besides the metabolic advantages, yoga is cost-effective, safe, culturally accepted and easily incorporated into everyday life, making it an appealing additional therapy to standard diabetes treatment. While there is increasing evidence that it can be helpful in diabetes management, additional research is required to assess its efficacy across various populations and clinical contexts. Hence the present study was designed to assess the effectiveness of Yoga as an adjunct therapy in type 2 diabetes mellitus focusing on its effect on lipid profile and quality of life.

## 2. MATERIALS AND METHODS

The study was a prospective interventional study, carried out in the Department of Medicine, Muzaffarnagar Medical College and Hospital, Muzaffarnagar, Uttar Pradesh, India. One hundred patients with known type 2 diabetes mellitus (T2DM) on routine anti diabetic therapy were selected from Medicine

Outpatient Department and the Medicine wards. The eligible participants were adults over 19 years of age, cooperative, non-smokers, non-alcoholics, and able to provide written informed consent. Patients with severe diabetic complications (cardio-vascular, renal, visual and cerebro-vascular), patients on lipid lowering drugs, patients younger than 19 years and patients who were not willing to participate were excluded from the study.

The enrolled patients were divided into two groups of 50 patients. Yoga therapy was added to the standard medical treatment for Group A while Group B continued standard treatment only and were the control group. The yoga intervention was for 6 months and was developed by a certified yoga instructor with the help of a physician. Twenty minutes of pranayama, 10 minutes of dynamic warm up exercises, 20 minutes of yogic postures (asanas) and 10 minutes of relaxation in savasana were included in each session. Participants took part in one weekly supervised session for 24 weeks, and they were instructed to practice the yoga postures daily at home. To increase adherence, a diagrammed yoga booklet and a diary were given to participants to document dietary changes, medication use, symptoms, blood pressure readings and blood glucose levels each week.

All the participants were clinically evaluated in detail at baseline, with medical history, general physical examination, and systemic examination. Follow-up evaluation was conducted at 3 and 6 months. Laboratory tests performed were fasting blood sugar (FBS), postprandial blood sugar (PPBS), glycated hemoglobin (HbA1c), total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL) and triglycerides. A standardized scoring system was also used to determine quality of life at follow-up visits. Other hematological, biochemical and radiological investigations were carried out as clinically indicated.

The data collected were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0 (IBM Corp., Armonk, NY, USA). The continuous variables were presented as mean  $\pm$  standard deviation (SD) and categorical variables were presented as frequencies and percentages. Independent Student's t-test was used to compare the two study groups at different time points for continuous variables and Chi-square was used for categorical variables. Statistically significant results were set at a p value of  $< 0.05$ .

## 3. RESULTS

A total of 100 patients with type 2 diabetes mellitus were enrolled and equally allocated to Group A (Yoga Therapy, n=50) and Group B (No Yoga Therapy, n=50). The baseline demographic and clinical characteristics were comparable between the two groups. The majority of participants belonged to the 41–50 years age group. Mean age was  $43.94 \pm 8.24$  years in Group A and  $43.14 \pm 7.74$  years in Group B ( $p=0.621$ ). Male participants constituted 62.0% and 54.0% of Groups A and B, respectively. Mean BMI, duration of diabetes, prevalence of diabetes-related complications, family history of diabetes, and dietary patterns were similar between groups ( $p>0.05$  for all), indicating baseline homogeneity. (Table 1)

**Table 1:** Baseline Demographic and Clinical Characteristics

Variable	Group A (Yoga Therapy) (n=50)	Group B (No Yoga Therapy) (n=50)	p-value
Age (years), Mean ± SD	43.94 ± 8.24	43.14 ± 7.74	0.621
Male Gender, n (%)	31 (62.0)	27 (54.0)	0.418
BMI (kg/m <sup>2</sup> ), Mean ± SD	28.48 ± 3.90	29.14 ± 3.83	0.397
Duration of T2DM (years), Mean ± SD	6.70 ± 4.24	7.32 ± 3.97	0.457
Diabetes-related Complications, n (%)	17 (34.0)	19 (38.0)	0.677
Family History of Diabetes, n (%)	23 (46.0)	26 (52.0)	0.548
Mixed Diet, n (%)	29 (58.0)	32 (64.0)	0.539

Fatigue was the most common presenting symptom in both groups, followed by polyuria and polydipsia. No significant

differences were observed in symptom distribution between the groups. (Table 2)

**Table 2:** Baseline Symptom Profile

Symptom	Group A n (%)	Group B n (%)	p-value
Fatigue	16 (32.0)	15 (30.0)	0.829
Polyuria	13 (26.0)	12 (24.0)	0.817
Polydipsia	13 (26.0)	12 (24.0)	0.817
Blurred Vision	10 (20.0)	9 (18.0)	0.799

At baseline, fasting blood sugar (FBS), postprandial blood sugar (PPBS), and HbA1c levels were comparable between the two groups. During follow-up, patients practising yoga demonstrated significantly greater reductions in all glycemic

parameters compared with controls. Significant differences emerged by 3 months and became more pronounced at 6 months, indicating improved glycemic control associated with yoga therapy. (Table 3)

**Table 3:** Comparison of Glycemic Parameters During Follow-up

Parameter	Time Point	Group A (Yoga Therapy) Mean ± SD	Group B (No Yoga Therapy) Mean ± SD	p-value
FBS (mg/dL)	Baseline	148.38 ± 6.31	149.84 ± 6.61	0.266
	3 Months	131.98 ± 7.10	135.46 ± 7.04	0.017
	6 Months	120.52 ± 9.12	125.72 ± 7.06	0.002
PPBS (mg/dL)	Baseline	219.26 ± 6.73	220.52 ± 5.73	0.321
	3 Months	197.76 ± 7.13	201.00 ± 5.59	0.014
	6 Months	181.30 ± 11.28	186.74 ± 5.49	0.003
HbA1c (%)	Baseline	7.79 ± 0.39	7.87 ± 0.62	0.437
	3 Months	7.17 ± 0.38	7.39 ± 0.71	0.051
	6 Months	6.68 ± 0.41	7.00 ± 0.70	0.007

Baseline lipid profile parameters were similar in both groups. However, participants receiving yoga therapy exhibited significant improvements in lipid profile during follow-up.

Total cholesterol, LDL cholesterol, and triglycerides decreased significantly, whereas HDL cholesterol increased significantly compared with the control group at both 3 and 6 months. (Table 4)

**Table 4:** Comparison of Lipid Profile During Follow-up

Parameter	Time Point	Group A Mean ± SD	Group B Mean ± SD	p-value
Total Cholesterol (mg/dL)	Baseline	219.58 ± 5.77	220.20 ± 6.55	0.620
	3 Months	198.16 ± 8.18	205.78 ± 7.17	<0.0001
	6 Months	184.12 ± 15.30	196.76 ± 7.66	<0.0001
LDL (mg/dL)	Baseline	149.66 ± 5.52	150.10 ± 5.59	0.696
	3 Months	137.82 ± 5.85	140.52 ± 5.37	0.019
	6 Months	123.92 ± 14.00	130.80 ± 5.46	0.002
HDL (mg/dL)	Baseline	40.30 ± 5.44	38.58 ± 5.58	0.126
	3 Months	46.02 ± 2.89	40.82 ± 5.68	<0.0001
	6 Months	47.70 ± 7.40	41.96 ± 5.81	<0.0001
Triglycerides (mg/dL)	Baseline	179.74 ± 5.78	178.32 ± 5.60	0.220
	3 Months	154.52 ± 10.41	164.20 ± 5.37	<0.0001
	6 Months	142.46 ± 13.41	154.34 ± 5.54	<0.0001

Quality of life scores were comparable at baseline between the two groups. Participants receiving yoga therapy demonstrated significantly greater improvement in quality of life at both 3-

month and 6-month follow-up assessments compared with controls. (Table 5)

Table 5: Comparison of Quality-of-Life Scores During Follow-up

Time Point	Group A (Yoga Therapy) Mean $\pm$ SD	Group B (No Yoga Therapy) Mean $\pm$ SD	p-value
Baseline	49.16 $\pm$ 6.06	48.96 $\pm$ 6.42	0.874
3 Months	57.24 $\pm$ 3.80	54.76 $\pm$ 6.61	0.025
6 Months	64.02 $\pm$ 4.80	60.42 $\pm$ 6.51	0.002

#### 4. DISCUSSION

The present study has shown that structured yoga therapy along with conventional treatment has shown significant improvement in glycemic control in patients with type 2 diabetes mellitus. In the yoga group, fasting blood sugar decreased from 148.38  $\pm$  6.31 mg/dL at baseline to 120.52  $\pm$  9.12 mg/dL at 6 months, whereas the control group showed a comparatively smaller reduction from 149.84  $\pm$  6.61 mg/dL to 125.72  $\pm$  7.06 mg/dL ( $p=0.002$ ). Similarly, postprandial blood sugar declined from 219.26  $\pm$  6.73 mg/dL to 181.30  $\pm$  11.28 mg/dL in the yoga group compared with 220.52  $\pm$  5.73 mg/dL to 186.74  $\pm$  5.49 mg/dL in controls ( $p=0.003$ ). HbA1c levels also showed a significant reduction from 7.79  $\pm$  0.39% to 6.68  $\pm$  0.41% among yoga participants, while the control group demonstrated a lesser decline from 7.87  $\pm$  0.62% to 7.00  $\pm$  0.70% ( $p=0.007$ ). These findings are similar to that of Sorout et al. who found that fasting glucose level decreased from 132.48  $\pm$  53.14 mg/dL to 105.77  $\pm$  28.54 mg/dL after six months of yoga intervention [15]. Shelke et al. observed a significant decrease in fasting glucose from 108.4  $\pm$  28.1 mg/dL to 101.5  $\pm$  27.6 mg/dL and HbA1c from 6.0  $\pm$  0.9% to 5.6  $\pm$  0.9% following yoga practice [16]. Likewise, Dash et al. reported reductions in fasting blood glucose from 178.53  $\pm$  64.92 mg/dL to 119.20  $\pm$  22.14 mg/dL and HbA1c from 7.73  $\pm$  0.51% to 7.61  $\pm$  0.68%, supporting the beneficial effects of yoga on glycemic regulation [17].

A significant finding of the present study was that the lipid profile was improved significantly after the yoga therapy. Total cholesterol decreased by approximately 35.5 mg/dL in the yoga group, from 219.58  $\pm$  5.77 mg/dL at baseline to 184.12  $\pm$  15.30 mg/dL at 6 months, whereas the control group showed a smaller reduction from 220.20  $\pm$  6.55 mg/dL to 196.76  $\pm$  7.66 mg/dL ( $p<0.0001$ ). LDL cholesterol decreased from 149.66  $\pm$  5.52 mg/dL to 123.92  $\pm$  14.00 mg/dL in the yoga group compared with 150.10  $\pm$  5.59 mg/dL to 130.80  $\pm$  5.46 mg/dL in controls ( $p=0.002$ ). Triglyceride levels fell from 179.74  $\pm$  5.78 mg/dL to 142.46  $\pm$  13.41 mg/dL among yoga participants, whereas the control group recorded levels of 154.34  $\pm$  5.54 mg/dL at 6 months ( $p<0.0001$ ). Conversely, HDL cholesterol increased significantly from 40.30  $\pm$  5.44 mg/dL to 47.70  $\pm$  7.40 mg/dL in the yoga group compared with an increase from 38.58  $\pm$  5.58 mg/dL to 41.96  $\pm$  5.81 mg/dL in controls ( $p<0.0001$ ). These findings closely resemble those reported by Sorout et al., who observed reductions in total cholesterol from 204.78  $\pm$  37.28 mg/dL to 180.05  $\pm$  25.27 mg/dL, LDL cholesterol from 124.87  $\pm$  31.07 mg/dL to 104.25  $\pm$  21.89 mg/dL, and triglycerides from 170.21  $\pm$  54.52 mg/dL to 128.70  $\pm$  32.32 mg/dL, along with an increase in HDL cholesterol from 39.08  $\pm$  10.91 mg/dL to 43.64  $\pm$  9.02 mg/dL [15]. Similarly, Shelke et al. reported reductions in total cholesterol from 216.3  $\pm$  46.1 mg/dL to 182.1  $\pm$  35.5 mg/dL, LDL cholesterol from 129.8  $\pm$  33.1 mg/dL to 112.0  $\pm$  32.6 mg/dL, and triglycerides from 140.4  $\pm$  53.0 mg/dL to 99.8  $\pm$  27.3 mg/dL after yoga intervention [16].

The beneficial metabolic changes seen in the current study might be due to the combined effect of physical activity, autonomic regulation and stress reduction from yoga. Asana and Pranayama practice has been proved to increase insulin sensitivity, increase peripheral glucose uptake, decrease cortisol secretion and increase the utilization of lipids. Gupta et al. reported reductions in total cholesterol from 216.52  $\pm$  26.00 mg/dL to 203.54  $\pm$  23.12 mg/dL, LDL cholesterol from 122.46  $\pm$  23.33 mg/dL to 113.76  $\pm$  18.49 mg/dL, triglycerides from 178.02  $\pm$  37.85 mg/dL to 154.65  $\pm$  33.75 mg/dL, and an increase in HDL cholesterol from 40.98  $\pm$  8.95 mg/dL to 48.20  $\pm$  6.23 mg/dL following yoga intervention [18]. Moreover, systematic review by Ghazvinih et al. and meta-analysis by Chen et al. showed that yoga generally improves fasting glucose, HbA1c, total cholesterol, LDL cholesterol and triglyceride levels in various populations with clinically significant effects [14,19]. The overall results provide a strong argument for the use of yoga as an effective complementary intervention in the overall management of type 2 diabetes mellitus.

Along with biochemical changes, there was also a remarkable improvement in the quality of life with Yoga Therapy. In the present study, quality-of-life scores increased from 49.16  $\pm$  6.06 at baseline to 64.02  $\pm$  4.80 at six months in the yoga group, whereas the control group improved from 48.96  $\pm$  6.42 to 60.42  $\pm$  6.51 ( $p=0.002$ ). The overall improvement seen in yoga practitioners could be due to their improved physical function, metabolic control, decreased psychological stress, better sleep quality, and emotional well-being. These results are in line with earlier studies which have reported beneficial effects of yoga on both physical and mental health outcomes in patients with chronic metabolic diseases. The present study showed simultaneous improvement in glycemic status, lipid profile and quality of life, which reflects the multi-dimensional benefits of yoga and the usefulness of yoga as an adjunct to conventional diabetes management.

The present study has some limitations that the study was performed in a single center with a relatively small number of patients, which may restrict the applicability of the results. The follow-up period was limited to six months, so the sustainability of the observed benefits could not be evaluated. Home practice was self-reported and may have been subject to reporting bias. Further, markers of inflammation, oxidative stress, or insulin resistance were not assessed in the study which could have provided a better understanding of the mechanisms by which yoga is beneficial.

#### 5. CONCLUSION

The present study demonstrated that the addition of structured yoga therapy to standard medical treatment significantly improved glycemic control, lipid profile parameters, and quality of life in patients with type 2 diabetes mellitus. Participants

practicing yoga showed greater reductions in fasting blood sugar, postprandial blood sugar, HbA1c, total cholesterol, LDL cholesterol, and triglycerides, along with a significant increase in HDL cholesterol and improved quality-of-life scores compared to those receiving standard care alone. These findings suggest that yoga is a safe, cost-effective, and beneficial adjunctive intervention that can complement conventional diabetes management and contribute to improved metabolic and overall health outcomes.

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