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Effects of yoga asanas and pranayama in non-insulin dependent diabetes mellitus

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Twenty Type 2 diabetic subjects between the age group of 30–60 years were studied to see the effect of 40 days of *Yoga asanas* on biochemical profile. The duration of diabetes ranged from 0 to 10 years. Subjects suffering from cardiac, renal and proliferative retinal complications were excluded from the study. *Yoga asanas* included *Surya Namaskar*, *Tadasan*, *Konasan*, *Padmasan*, *Pranayama*, *Paschimottanasan*, *Ardhmatsyendrasan*, *Shavasan*, *Pavanmuktasan*, *Sarpasan* and *Shavasan*. Subjects were called to the cardio-respiratory laboratory in the morning time and were given training by the *Yoga* expert. The *Yogic* exercises were performed for 30 – 40 minutes every day for 40 days in the above sequence. The subjects were prescribed medicines and diet. The basal blood glucose, lipid profile and glycosylated haemoglobin was measured and repeated after 40 days of *yoga asanas*. There was a statistically significant decrease in fasting blood glucose (from baseline 208.3 ± 20.0 to 171.7 ± 19.5 mg/dl) and decrease in Postprandial blood glucose (from 295.3 ± 22.0 to 269.7± 19.9 mg/dl). The decreases in values of serum cholesterol were also statistically significant (from 222.8 ± 10.2 to 207.9 ± 8.6 mg/dl). The triglyceride decreased (from 168.5 ± 15.5 to 146.3 ±13.5 mg/dl), low-density lipoprotein cholesterol and very low-density lipoprotein improved (from 144.8 ± 8.6 to 140.70 ± 7.9 mg/dl and from 37.4 ± 4.6 to 32.1 ± 3.4 mg/dl). The glycosylated haemoglobin decreased from 10.27 ±0.5 to 8.68 ± 0.4 %. These findings suggest that *yoga asanas* have a beneficial effect on glycaemic control and lipid profile in mild to moderate Type 2 diabetes.

Keywords: *Yoga asanas*, *Pranayama*, Non-insulin dependent diabetes mellitus.

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A thin person who has a total deficiency of insulin and needs insulin injections is diagnosed as having Type 1 diabetes (Insulin Dependent Diabetes Mellitus or IDDM). Type 2 diabetic (Non-Insulin Dependent Diabetes Mellitus or NIDDM) is usually an overweight individual whose insulin secretion is normal. The insulin

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cannot however act at the site of tissues and is managed on a weight loss regime of exercise, diet and oral hypoglycemic medications. In addition to the increased levels of glucose, metabolic disorders of plasma lipid occur in NIDDM patients. The dyslipidemia of NIDDM is closely related to insulin resistance syndrome of obesity, hypertension, glucose intolerance and accelerated atherosclerosis[1]. In this context, exercise in diabetic patients can improve insulin sensitivity, glycaemic control and lipid profile[2]. However the levels of physical training recommended for NIDDM patients i.e. 50-70% of maximum aerobic capacity lasting 30 minutes, three to five times a week[3] are not feasible in many patients because of age, obesity, cardiovascular disease and other problems. Long-term motivation and compliance are also poor in such cases[4,5].

The intensity and duration of exercise required to decrease LDL and increase HDL cholesterol are probably beyond those that can be accomplished by most NIDDM patients[6,7].

Yoga has been applied in the field of therapeutics in modern times. Studies have been conducted to understand changes occurring during *Yogic* exercises (*asanas* and *pranayamas*). Significant physical, physiological, psychological and endocrinal changes have been reported by following various *Yogic* regimes over a period of time[8,9]. *Yoga* has thus aroused a hope for the diabetic patients to have complication free life with relatively less medication[10]. The limited recorded evidences show the positive impact of *Yogic* exercises on studying blood sugar levels[10]. The effects on other important aspects of Diabetes Mellitus like serum insulin and, serum lipid profile are virtually non-existent.

In this study it is endeavored to scientifically study the role and the effect of *Yogic* exercises on Type 2 diabetes mellitus patients by measuring the parameters like blood glucose, serum lipid profile, glycosylated haemoglobin, serum insulin using modern techniques.

Methods

Screening and Methodology

Four men and thirty-four women of NIDDM (mild to moderate diabetics) in the age group of 30 to 60 years were selected from the outpatient clinic of G.T.B. Hospital, Delhi for the present study.

Exclusion and Inclusion Criteria

All the patients were non-smokers, middle class, literate and were on anti-diabetic drugs and diet control (duration 1 to 10 years). None of the patients had apparent cardiac, renal, hepatic, retinal or any other complication. A baseline ECG (Electrocardiogram), KFT (Kidney Function Tests), LFT (Liver Function Tests), ophthalmological and neurological examination was done to rule out the above diseases. Written consent was taken from them. Every one received personalised attention and supervision of a *yoga* expert during *yoga* sessions, carried out in the cardio-respiratory laboratory in Physiology Department in the morning time (30-40 min) every day for 40 days. Patients were kept on the same drug and diet control throughout the study before and after *yoga* therapy.

Table 1—Name and duration of various *asanas* included in *yogic* exercises[10,15]

S. No.	Name	Duration
1.	*Surya Namaskar 1*	3-7 turns of each, the pose being maintained for ten seconds adding one turn each, every fortnight
2.	*Surya Namaskar 2*	3-7 turns of each, the pose being maintained for ten seconds adding one turn each, every fortnight
3.	*Tadasana*	¼ minute to one minute , adding ¼ minute per week
4.	*Trikonaasana*	¼ minute to one minute for each side, adding ¼ minute per week
5.	*Sukhasana*	¼ minute to one minute, adding ¼ minute per week
6.	*Padmasana*	¼ minute to one minute, adding ¼ minute per week
7.	*Bhastrika Pranayama*	5-15 minutes per day
8.	*Paschimottanasana*	¼ minute to one minute for each side, adding ¼ minute per week
9.	*Ardhmatsyendrasana*	¼ minute to one minute for each side, adding ¼ minute per week
10.	*Vajrasana*	¼ minute to one minute, adding ¼ minute per week
11.	*Pawanmuktasana*	¼ minute to one minute for each side , adding ¼ minute per week
12.	*Naukasana*	3-7 turns of each, the pose being maintained for ten seconds adding one turn each, every fortnight
13.	*Bhujangasana*	3-7 turns of each, the pose being maintained for ten seconds adding one turn each, every fortnight
14.	*Dhanurasana*	3-7 turns of each, the pose being maintained for ten seconds adding one turn each, every fortnight
15.	*Shavasana*	2-10 minutes, adding 2 minutes per week

Thirteen specific *Yoga asanas* and *Pranayama* done by Type 2 diabetes patients, viz. *Surya Namaskar, Trikonasana, Tadasana, Sukhasana, Padmasana, Bhastrika Pranayama, Pashimottanasana, Ardhmatsyendrasana, Pawanmuktasana, Bhujangasana, Vajrasana, Dhanurasana* and *Shavasana* are beneficial for diabetes mellitus[10] (Table 1).

Their basal parameters included biochemical investigations FBG, PPG, (fasting blood and postprandial glucose), HbA_1 level (glycosylated haemoglobin) and lipid profile besides having ECG, nerve conduction and pulmonary function

Table 2—Fasting blood glucose (FBG), Postprandial blood glucose (PPG), Glycosylated haemoglobin (HbA_1) and Lipid profile values before and after 40 days of *Yoga asanas*

	N	Mean ± S.D.		P Value
		Before	After	
FBG (*mg/dl*)	20	208.3 ± 20.0	171.7 ± 19.50	0.001
PPG *mg/dl*)	20	295.3 ± 22.0	269.7 ± 19.9	0.059
HbA_1 (%)	20	10.27± 0.5	8.68 ± 0.4	0.004
Chol (mg/dl)	22	222.8 ± 10.2	207.9 ± 8.6	0.003
TG (*mg/dl)*	22	168.5 ± 15.5	146.3 ± 13.5	0.075
LDL (*mg/dl)*	22	144.8 ± 8.6	140.7 ± 7.9	0.309
HDL1 (*mg/dl)*	22	43.8 ± 2.6	40.7 ± 1.9	0.309
VLDL1 (*mg/dl)*	22	37.4 ± 4.6	32.1 ± 3.4	0.059
Chol/HDL	22	4.76 ± 0.06	4.55 ± 0.05	0.154

tests. Blood sugar measurements were done by glucose oxidase method by Trinder[11], HbA_1 by ion exchange resin kit (Stangen immunodiagnostics) and lipid profile. Serum Lipid Profile was estimated by enzymatic method using standard kits. Accurex Precipitate Limited Autozyme measured HDL cholesterol. This method precipitates chlyomicrons, LDL, VLDL (Apo B) and the HDL cholesterol in the supernatant is measured. Total cholesterol was measured by Ranbaxy Enzolut, in which an analyzer using a green filter at 500 nm measured H_2O_2 action. Randox kit estimated triglycerides by glycerophosphate oxidase (gpo) and peroxidase enzymes (GPO-PAP) method[12-14].

Table 1 shows the different *asanas* done with their time duration[10,15]. Blood glucose (fasting and postprandial), HbA1 and lipid profile were estimated before and after 40 days of *yoga asanas*.

Results

Paired readings before and after the *yoga asanas* were taken and analysed.

Table 2 and Figures 1,2,3 show the glycaemic control, as well as HbA1 and lipid profile levels of 20 subjects. Fasting blood glucose was reduced from 208.3 ± 20.0 to 171.7 ± 19.5 mg/dl, postprandial blood glucose (PPG) from 295.3 ± 22.0 to

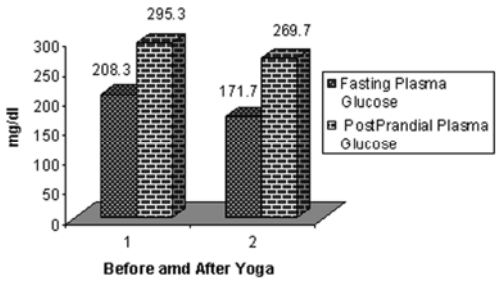

Fig. 1

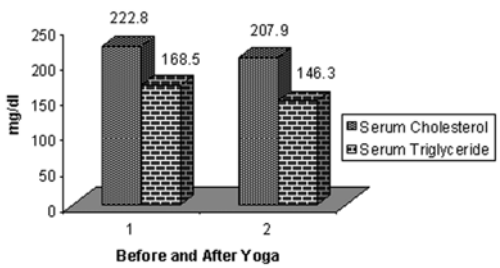

Fig. 2

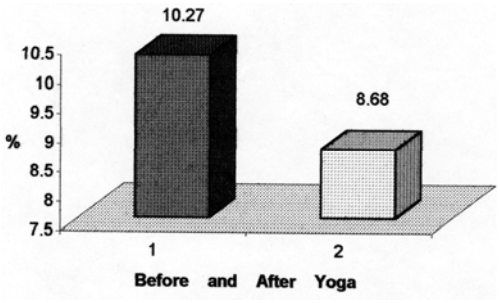

Fig. 3—HbA_1 level

269.7 ± 19.9 mg/dl ($p < 0.001$ for FPG), HbA_1 from 10.27 ± 0.5 to 8.68 ± 0.4 %. Serum cholesterol, triglyceride decreased from 222.8 ± 10.2 to 207.9 ± 8.6 mg/dl and from 168.5 ± 15.5 to 146.3 ±13.5 mg/dl ($p < 0.003$ for cholesterol), low density lipoprotein cholesterol and very low density improved from 144.8 ± 8.6 to 140.70 ± 7.9 mg/dl and from 37.4 ± 4.6 to 32.1 ± 3.4 mg/dl, Cholesterol/HDL ratio decreased from 4.76 ± 0.06 to 4.55 ± 0.05 thereby indicating an improved glycaemic control and lipid profile.

Discussion

In the present study, there occurred a significant reduction in total cholesterol. There was a noticeable decrease in triglyceride, LDL and VLDL cholesterol (Table 2 and Figure 1,2). Sahay *et al*[10] have also reported a significant decrease in free fatty acids, and a significant reduction in serum lipase activity in diabetics after *Yoga* practice. Free fatty acids are insulin antagonist; reduction of its levels is associated with improved diabetic status[16,17].

There occurred a significant fall in the fasting blood glucose. One hour postprandial blood glucose level also decreased after 40 days of *Yoga asanas* (Table 1 and Figure 1). The subjects developed a sense of well being within 10 days and there was a lowering of dosage of oral anti-diabetic drugs, which was confirmed on questioning. Data from some patients who discontinued *Yogic* practices for some time and restarted, showed poor control during the interval with return to normal values after restarting the *Yoga* practices, which confirms "Cause and Effect Relationship between *Yoga asanas* and the Blood Glucose Levels"[18-21] in mild diabetics to avoid hypoglycemic complications. In the present study, there occurred a decrease in glycosylated haemoglobin in the NIDDM patients undergoing *Yoga* practice. Glycosylated haemoglobin is high in diabetics with chronic hyperglycemia and reflects their metabolic control. Dang & Sahay[10] have reported a decrease in glycosylated haemoglobin to normal levels after *Yoga asanas*.

A feeling of general well being, alertness and attentiveness without any side effects was felt[10]. The exact mechanism of action of *Yoga asanas* is unknown. It is postulated that direct rejuvenation/regeneration of cells of pancreas may be taking place, which may increase utilisation and metabolism of glucose in the peripheral tissues, liver and adipose tissues through enzymatic process[10,20,21].

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References

1 Pickup J C & Williams G, Textbook of Diabetes, Vol. 2 (Second Edition), (Blackwell Scientific Publications, Oxford, London), 1997.

2 Schneider S H & Ruderman N B, Exercise and NIDDM, Technical Review, *Diabetes Care*, 13 (1990) 785-89.

3 Skarfors E T, Wegener T A, Lithel H & Sclimers I, Physical training as treatment for Type II (non insulin dependent) Diabetes in elderly men: a feasibility of study over two years, *Diabetologia*, 30 (1987) 930-3.

4 Hanefeld M, Fischer S & Schmeckel H, Diabetes intervention study: multi interventional trial in newly diagnosed NIDDM, *Diabetes Care,* 14 (1991) 308-17.

5 Superko H R, Exercise training, serum, lipids and lipoprotein particles: is there a change threshold?, *Med Sci Sports Excer*, 23 (1991) 677-85.

6 Vanninen E, Uusitupa M, Sittonenno O, Laitinen J & Lansimies E, Habitual physical activity, aerobic capacity and metabolic control in patients with newly diagnosed Type II (non insulin dependent) diabetes mellitus: effect of 1 year diet and exercise intervention, *Diabetologia*, 35 (1992) 340-6.

7 Udupa K N, Singh R H & Settiwar R M, A comparative study on the effect of some individual Yogic practices in normal persons, *Indian J Med Res*, 63 (1975) 1066-71.

8 Patel C, Randomised control trial of Yoga and biofeedback in management of hypertension, *The Lancet*, 19 (1975) 93-95.

9 Rugmini P S & Sinha R.N, The effect of Yoga therapy in Diabetes Mellitus. Seminar on Yoga, Man and Science, Delhi India. (1976) 175-189.Yoga Research Hospital, Vishwayatan Yogashram, CCRIMH, New Delhi.

10 Dang K K & Sahay B K, Yoga and meditation, *Medicine Update*, Volume 9, Part 1, Chapters 57 and 58 (1999), p 502-506, 507-512. The Association of Physicians of India Ed M.M. Singh. APICON, The Association of Physicians of India Conference, New Delhi,

11 Trinder P, Determination of glucose in blood using glucose oxidase with an alternative oxygen receptor, *Ann Clin Biochem*, 6 (1969), 24.

12 Allain C C, Poon L S, Chan C S, Richmond W & Fu P C, Enzymatic determination of total serum cholesterol, *Clinical Chem*, 20 (1974) 470.

13 Werner M & Gabrienlsen D G, Estimation of serum triglycerides, *Clinical Chem*, 27 (1981) 268.

14 Burnstein M, Sholnick H R & Morgin R, Rapid method for the isolation of lipoprotein from human serum by precipitation with polyanion, *J Lipid Res*, 11 (1970) 1583.

15 Swamy Vyas Dev Ji, First Steps to Higher Yoga. Translated by Bala-Brahmachari Dr. Ram Pyari Shastri, (Yoga Niketan Trust, Gangotri, Uttar-Kashi, Rishikesh, Uttarakhand), (The Raisana Printery), 1970, 59-281.

16 Uusitupa M, Sitonen O & Vontilainen E, Serum lipids and lipoproteins in newly diagnosed non-insulin dependent (Type II) diabetics with special reference to factors influencing HDL cholesterol and triglyceride levels, *Diabetes Care*, 9 (1986) 17-22.

17 Laakso M, Sitonen O & Vontilainen E, Insulin resistance is associated with lipid and lipoprotein abnormalities in subjects with varying degrees of glucose intolerance, *Arteriosclerosis*, 10 (1990) 223-31.

18 Udupa K N & Singh R H, The scientific basis of Yoga, *J American Medical Association*, 220(10) (1972) 1365.

19 Jain S C & Talukdar B, Role of yoga in control of hyperglycaemia in middle aged patients of non-insulin dependent diabetes mellitus, *Indian J Clin Biochem*, 10(2) (1995) 62-65.

20 Sahay B K & Murthy K J R, Long-term follow up studies on effect of yoga in diabetes, *Diab Res Clin Pract,* 5(Suppl. 1) (1988) S655.

21 Sahay B K, Yoga and Diabetes, In: *Proceedings of Noro Nordisk diabetes update*. Ed. Anil Kapur, (Health Care Communication, Bombay, India), 1994, 159-167.