

## Effects of yoga - pranayama practices on metabolic parameters and anthropometry in type 2 diabetes

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### Abstract

India being the diabetic capital of the world, there is a rise in the incidence of type 2 diabetes with the increase in age, physical inactivity and sedentary lifestyle. So, the present study was undertaken to assess the strength of association of these factors and the effects of yoga-pranayama in type 2 diabetes. We selected 44 uncomplicated type 2 diabetic patients in the age group of 40-55 years with diabetes duration of 1-10 years. They were divided into test group and control groups with 22 patients in each group. The test group (T1 and T2) were taught yoga and pranayama for 3 continuous months, 1 hour every day in the morning by yoga expert. The results showed significant decrease in metabolic parameters, with  $p < 0.001$  in FBS of both the T1 and T2 sub groups [T1-  $182.87 \pm 45.55$  to  $135.77 \pm 38.88$ , T 2 -  $160.64 \pm 41.22$  to  $130.82 \pm 36.11$ ], PPBS with  $p < 0.001$  [T1-  $270.64 \pm 76.6$  to  $196.90 \pm 64.67$ , T 2 -  $230.62 \pm 71.32$  to  $183.46 \pm 52.20$ ], Hb A 1c with  $p < 0.001$  in both the T1 and T2 sub groups, [T1-  $9.77 \pm 0.5\%$  to  $7.68 \pm 0.4\%$  and T 2 -  $8.46 \pm 0.3\%$  to  $7.23 \pm 0.3\%$ ]. There was significant decrease with  $p < 0.001$  in triglycerides of both the T1 and T2 sub groups, [T1-  $170 \pm 70.55$  to  $132.2 \pm 60.6$ , T 2 -  $164 \pm 80.66$  to  $1143.1 \pm 28.89$ ]. There was significant decrease with  $p < 0.001$  in LDL of both the T1 and T2 sub groups [T1-  $108 \pm 36.24$  to  $98 \pm 33.2$ , T 2 -  $101.28 \pm 32.34$  to  $86.21 \pm 27.2$ ]. However, no significant change in HDL levels in test groups (T1 and T2). It also showed significant decrease in weight, BMI and waist- hip ratio in test group. Addition to above benefits there was significant decrease in the requirement of insulin per day in the T2, from  $36.42 \pm 4.2$  units to  $31.48 \pm 3.2$  units. There were no significant changes in the control group. Thereby concluding that, there are significant benefits of yoga-pranayama practices on metabolic parameters and anthropometric measurements in uncomplicated type 2 diabetes.

**Keywords:** Yoga, Pranayama, Diabetes, Glycosylated hemoglobin

**Abbreviations Used:** FBS: fasting blood sugar, PPBS: post prandial blood sugar, HbA1C: glycosylated hemoglobin, LDL: low density lipoprotein, HDL: high density lipoprotein, TG: triglycerides, TC: total cholesterol, SD: standard deviation, ANOVA: analysis of variance, BMI: body mass index, OHA: oral hypoglycemic agents

### INTRODUCTION

Diabetes is a complex metabolic syndrome with absolute or relative deficiency or inefficiency of insulin. [1] In type 2 diabetes, most patients are obese when they develop diabetes and the obesity is becoming a major health hazard worldwide. The incidence of type 2 diabetes is also increasing with the increase in age, physical inactivity and sedentary lifestyle. Its strong familial predisposition makes the situation even worse with the result that children and adolescents now present with juvenile diabetes. [2, 3, 4]

For many physically inactive people who are overweight, any kind of physical activity appears difficult, and this often prevents

people who are obese from initiating and adhering to a specific form of physical activity. [5] 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. [6] Among different yoga techniques, breathing practices (*pranayamas*) can be performed while seated, and are less challenging for people who are physically inactive.[7] Yoga has proven its efficacy in the improvement of oxidative stress as well as in improving the glycemic status of diabetics through neuroendocrinal mechanisms.[8] This study was under taken to see the effects of 3 months of yoga-pranayama practices on metabolic parameters like FBS, PPBS, Hb A1c, lipid profile and anthropometric measurements like weight, BMI, Waist-hip ratio in uncomplicated type 2 diabetes patients. Also we tested any effect on modification of daily dosage of insulin.

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### METHODS

The study was conducted from January to March 2011 in Department of Physiology, Dr. B R Ambedkar Medical College,

Kadugondana Halli, Bangalore and Healing touch Yoga Centre, Bangalore. Ethical clearance was obtained from institutional ethics committee, Dr. B R Ambedkar Medical College, Kadugondana Halli, Bangalore. After taking consent, 44 type 2 diabetic patients were selected in the age group of 40-55 years with diabetes duration 1-10 years. Patients with features of micro and macro vascular complications of diabetes were excluded. They were divided into test group (who underwent yoga practice) and control group (who did not undergo any yoga practice). The test group consisting of 22 patients was further divided into 2 sub group T1 and T2. T1 group consisting of 16 patients were on oral drugs only whereas T2 group consisting 6 patients were on oral drugs and insulin. The test groups were taught yoga and pranayama for 3 continuous months, 1 hour every day in the morning between 7.00 am and 8.00 am by yoga expert. The control group involved 22 patients and were on treatment did not undergo any yoga practice. Both the test and control groups were asked to continue same medications throughout the study period. Blood samples for FBS, PPBS, Hb A1c, lipid profile and anthropometric measurements like weight, BMI, Waist-hip ratio were estimated before the starting and at the end of the study period. The data obtained was analyzed using appropriate statistical methods like SD, ANOVA, t-test for paired data etc.

### Name and duration of various pranayamas & yogaasanas included in yogic practice

#### Pranayama

1. Bhastrika- pranayama, 3-5 mins per day
2. Kapal- bhati, 5-7mins per day
3. Anulom-viloma, 5-10 mins per day
4. Bhramari, 5 times a day
5. Udgjit-Om Uccharan, 5 times a day

#### Yoga-asanas

1. Surya namakar, 3-7 turns of each, the pose being maintained for ten seconds adding each turn, every fortnight
2. Tadasana, ¼ minute to one minute for adding ¼ minute per week.
3. Trikona-asana, ¼ minute to one minute for each side, adding ¼ minute per week
4. Pashimottanasana, ¼ minute to one minute adding ¼ minute per week
5. Bhujangasana, 3-7 turns of each, the pose being maintained for ten seconds adding one turn each, every fortnight
6. Vajrasana, ¼ min to 1 min adding ¼ min per week
7. Shalabasana, ¼ min to 1 min adding ¼ min per week
8. Shavasana, 2- 5 minutes, adding 1 minute per week

## RESULTS

Table 1: Metabolic parameters in Type 2 diabetes patients of test group and control group

Parameters	Test group		Control group			
	T1 (Only on OHA's)		T2 (On OHA's + Insulin)		Before	After 3 months
	Before	After 3 months	Before	After 3 months	Before	After 3 months
FBS	182.87 ± 45.55	135.77 ± 38.88*	160.64 ± 41.22	130.82 ± 36.11*	174.52 ± 34.91	169.40 ± 38.32
PPBS	270.64 ± 76.6	196.90 ± 64.67	230.62 ± 71.32	183.46 ± 52.20*	262.27 ± 51.53	260.43 ± 50.22
HbA1c	9.75 ± 0.59	7.68 ± 0.4*	8.46 ± 0.3	7.23 ± 0.3*	10.46 ± 0.2	9.67 ± 0.3%
TC	178.90 ± 42.2	162.18 ± 32.34	162.32 ± 32.33	154 ± 31.78	187.4 ± 44.46	182.86 ± 42.66
Triglycerides	170 ± 70.55	132.2 ± 60.6*	164 ± 80.66	143.1 ± 28.89*	176 ± 72.62	172 ± 71.66
LDL	108 ± 36.24	98 ± 33.2*	101.28 ± 32.34	86.21 ± 27.2*	111.28 ± 36.64	110.21 ± 35.26
HDL	38.2 ± 4.86	38.3 ± 5.2	39.51 ± 3.88	39.59 ± 4.02	36.2 ± 4.25	36.4 ± 4.33
Requirement of Insulin/day			36.42 ± 4.2	31.48 ± 3.2*		

\*P<0.001, TC= Total cholesterol, OHA's = Oral Hypoglycemic agents

Table 2: Anthropometric measurements in test and control group

Parameters	Test group		Control group			
	T1		T2		Before	After 3 months
	Before	After 3 months	Before	After 3 months	Before	After 3 months
Weight	66.20 ± 4.45	61.60 ± 4.46*	64.20 ± 4.45	61.62 ± 4.42*	68.83 ± 4.27	63.92 ± 4.89
BMI	27.86 ± 1.54	24.98 ± 1.52*	26.86 ± 1.46	24.84 ± 1.48*	25.84 ± 1.76	26.02 ± 2.43
Waist hip ratio	0.91 ± 0.09	0.83 ± 0.07*	0.89 ± 0.08	0.81 ± 0.06*	0.90 ± 0.09	0.91 ± 0.09

\*P<0.001

Table 1 shows that there is significant decrease in FBS, PPBS and HbA1c of both the T1 and T2 sub groups with p < 0.001. Similar significant change in triglycerides and LDL of both the T1 and T2 sub groups with p < 0.001 was seen. There was no significant change in HDL levels both in test groups T1 and T2. There was no significant change in all the parameters of the control group. The requirement of insulin in the test group 2(T2) was significantly reduced after the yoga for 3months.

Table 2 indicates a significant decrease in the weight, BMI and waist- hip ratio in both T1 and T2 with p < 0.001. Such a significant change in the control group was not found.

## DISCUSSION

In the present study there was significant decrease in FBS, PPBS values in both the sub groups T 1 and T2 who underwent the 3 months yoga and pranayama practice. Similar findings were found by Malhotra [9], Savita s [10], Upadhyay VK [11]. The exact mechanisms of actions of yoga-asanas and pranayama in decreasing the blood sugar are still unknown. The possible mechanisms are a) direct rejuvenation/ regeneration of cells of pancreas due to abdominal stretching during yoga exercise, which may increase utilization and metabolism of glucose in peripheral tissues, liver and adipose tissues through enzymatic process.[12, 13, 14] b) More active practices followed by relaxing ones lead to deeper

relaxation than relaxing practices alone, documented by research from swami Vivekananda yoga research foundation near Bangalore city and possibility of neuroplasticity bringing about changes in the hypo-pituitary-pancreatic axis.[15] c) Muscular relaxation, development and improved blood supply to muscles might enhance insulin receptor expression on muscles causing increased glucose uptake by muscles and thus reducing blood sugar.[16]

There was significant decrease in the total cholesterol, triglycerides and LDL levels. Similar observations were found by Malhotra [9], Savita S [10], Vanish K Upadhyay [11] and Sahay [17] and Bijlani [18] reported a significant reduction in free fatty acids, LDL, VLDL and an increase in HDL. The improvement in the lipid profile after yoga could be due to increased hepatic lipase and lipoprotein lipase at cellular level, which affects the metabolism of lipoprotein and thus increase uptake of triglycerides by adipose tissues [19, 20]. There was no significant change in HDL levels in the present study. Similarly in a study conducted in Haridwar, India by Shirley T [21] to see the effects of Short term health impact of a yoga and diet change program on obesity found that there was decrease in the HDL levels which is not a favourable outcome. They reasoned that the decrease in HDL levels may more likely be due to a change in diet (with a decrease in saturated and monounsaturated fat and animal-source protein) rather than related to the practice of yoga. There was significant decrease in weight, BMI and waist-hip ratio. Similar findings were observed by Sahay [17] and Shirley T [21]. Also there was decrease in the HbA1c %. Similar findings was observed by Sahay.[17] Another important observation was that the insulin dose requirement per day in T2 significantly decreased. Similarly Sahay [17] and Savita S[10] reported a decrease in the drug requirements by some of the patients. Jain [22] also found that there was significant reduction in hyperglycemia with decrease in oral hypoglycemic drugs for maintenance of normoglycemia in response to yoga therapy. All the above beneficial effects suggest improvement in the insulin sensitivity following yogic exercises.

Addition to all above effects, following yoga-asanas and pranayamas, many patients reported a feeling of well being, more relaxed and satisfied, and a sense of relief from anxiety. They were more alert and active which could be due to release of opioids and altered adrenocortical activity. Yoga-asanas with its change in posture and controlled breathing in pranayama influences mental status of an individual allaying apprehension, stress and brings about feelings of well being and hormonal balance. Concordant findings were observed by Shirley T [21] and Udupa KN. [23]

#### Limitations

1. The numbers of patients involved were less.
2. Effect of diet modifications were not considered and assessed.
3. The parameters were taken only twice – Once, at the time of start and other at the end of 3 months, therefore the trend of reduction cannot be commented upon.

#### CONCLUSIONS

There are significant benefits of yoga- pranayama practices on metabolic parameters and anthropometric measurements in uncomplicated type 2 diabetic patients. Effects on HDL levels remained unexplainable. However, further research on effects of long term yoga-pranayama practices in diabetic patients need to be studied.

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