

## EFFECTS OF YOGA ON BLOOD GLUCOSE, INSULIN AND C-PEPTIDE LEVELS IN PATIENTS OF DIABETES MELLITUS

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**Abstract: Background and objectives:** With the increased prevalence of Diabetes Mellitus, there is urgent need for lifestyle modifications along with conventional drug therapy. Yoga has been found to be effective in delaying the progression and the resulting complications of the disease. The aim of this study was to evaluate the effect of yoga in patients of diabetes mellitus. **Methods:** Blood glucose levels (Fasting and Postprandial), Fasting serum insulin and c-peptide levels and anthropometric parameters of 30 patients of type 2 DM who were doing yoga under the supervision of yoga expert were measured before and after 45 days of yoga asana in the department of physiology and biochemistry and were analysed by using student t-test. **Results:** Fasting blood glucose levels, two hour postprandial blood glucose levels, Serum insulin and c-peptide levels along with weight and Body Mass Index were reduced significantly ( $p$  value  $<0.001$ ). **Conclusion:** The beneficial effect on insulin kinetics may be by improving the insulin sensitivity of the target tissues thus decreasing insulin resistance and consequently increasing peripheral utilization of glucose. The reduction in c-peptide levels is a good support to improved insulin resistance. Yoga asanas may be used as an adjunct with diet and drugs in the management of type 2 diabetes.

**Keywords:** Blood glucose, c-peptide, diabetes mellitus, insulin

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### Introduction:

Diabetes Mellitus represents a significant global health problem. According to WHO August 2011 fact sheet No.312, 346 million people worldwide have diabetes and it is projected that diabetic deaths will double between 2005 and 2030<sup>1</sup>. The incidence of DM is also increasing with the increase in unhealthy dietary habits, physical inactivity and sedentary lifestyle<sup>2</sup>. The two broad categories of DM are designated Type1 DM and Type2 DM. Both types of diabetes are preceded by a phase of abnormal glucose homeostasis as the pathogenic processes progresses. T1DM is the result of complete or near total insulin deficiency whereas T2DM is a heterogeneous group of disorders characterized by a variable degree of insulin resistance, impaired insulin secretion and increased glucose production<sup>3</sup>. At present, DM is treated using oral anti-diabetic drugs and/or insulin injections along with strict diet restriction on long term basis. Despite the

continuous treatment, there is every possibility of aggravation of the disease along with adverse reactions and side effects of the medications. Of particular concern are the comorbidities associated with the development of DM such as retinopathy, neuropathy, nephropathy, cardiovascular disease and peripheral artery disease<sup>4</sup>.

Lifestyle modifications, therefore, inclusive of dietary modification, regular physical activity and weight reduction in conjunction are indicated for the prevention and progression of diabetes<sup>5</sup>. Yoga, a vedic science is a mind-body approach which is highly appreciated and recommended and its health benefits are preventive as well as curative. Asanas are body postures held for 5-20 breaths, and pranayamas are controlled abdominal and diaphragmatic breathing movements<sup>6</sup>. Very scanty literature is available to see the beneficial effects of yoga on DM.

**Material and Methods:**

The present study has been done at Pt. J.N.M. medical college, Raipur (C.G.) during March 2012 to October 2013 after taking ethical clearance from ethical committee. This was an observational study which included 30 known subjects of Diabetes mellitus in the age group of 30-60 years who were coming to patanjali yoga sansthana, Raipur. Subjects who have signed informed consent and had registered within seven days of the first sample taken were included in the study. Subjects who were known case of retinopathy, cardiac complications, neurological problems and other major systemic problems were excluded from the study. They were doing yoga daily for 40-45 minutes in the morning. Thirteen asanas (surya namaskar, Tadaasan, Trikonasana, Paschimottanaasan, Vajraasan, Mandukaasan, Dhanurasana, Ardhmatsyendrasana, Pavanamuktasana, Bhujangasana) and pranayama (Bhastrika, Anulom vilom) and deep relaxation (Shavaasan) were done by them. Their blood samples were collected on the first day and after 45 days of yoga and the parameters were assessed in the department of physiology and biochemistry. 3 ml of venous blood was taken from the subject, of which 1 ml was used for estimation of fasting glucose and 2 ml of blood was allowed to clot and serum separated for estimation of Insulin and C-Peptide levels. After having breakfast 1ml of blood is taken again for estimation for post prandial glucose. Blood glucose levels were estimated by GOD-POD method and serum insulin and c-peptide levels were estimated by ELISA method. Their weight and BMI were also recorded before and after 45 days of yoga. Those who were taking drugs were continued on the same dosage of drugs.

**Statistical analysis:**

The result was expressed as mean  $\pm$  standard deviation and student t- test was used to calculate the level of significance. A p-value  $<$  0.05 is considered statistically significant.

**Result:**

Table 1 showed mean  $\pm$  standard deviation of blood glucose levels (fasting and postprandial), Table 2 showed fasting serum insulin and c-peptide levels and Table 3 showed weight and BMI in Type 2 DM subjects before and after yoga. All showed significant reduction ( $p <$  0.05) after the study.

**Table 1: Fasting and Postprandial blood glucose levels before and after yoga in Type 2 DM subjects**

	Pre-yoga Mean $\pm$ SD	Post-yoga Mean $\pm$ SD	p- value
Fasting blood glucose(mg/dl)	122.43 $\pm$ 47.73	99.9 $\pm$ 34.86	$<$ 0.001
Postprandial blood glucose(mg/dl)	204.46 $\pm$ 29.66	189.63 $\pm$ 27.37	$<$ 0.001

SD: standard deviation; p-value $<$ 0.05 is statistically significant

**Table 2: Fasting serum Insulin and C-Peptide levels before and after yoga in Type 2 DM subjects**

	Pre-yoga Mean $\pm$ SD	Post-yoga Mean $\pm$ SD	p- value
Serum Insulin( $\mu$ IU/ml)	15.81 $\pm$ 6.65	7.89 $\pm$ 6.58	$<$ 0.001
Serum C-peptide(ng/ml)	2.81 $\pm$ 1.19	1.21 $\pm$ 1.03	$<$ 0.001

SD: standard deviation; p-value $<$ 0.05 is statistically significant

**Table 3: Anthropometric parameters before and after yoga in Type 2 DM subjects**

	Pre-yoga Mean±SD	Post-yoga Mean±SD	p-value
Weight(kg)	76.66 ± 11.56	75 ± 11.52	<0.001
BMI(kg/m <sup>2</sup> )	28.12 ± 3.76	27.50 ± 3.72	<0.001

SD: standard deviation; p-value<0.05 is statistically significant

### Discussion:

Type 2 DM is a serious progressive disorder, it encompasses individuals who have insulin resistance and usually have relative (rather than absolute) deficiency of insulin. Insulin is a polypeptide hormone secreted by the beta cells of the islets of langerhans of the pancreas and is required for glucose homeostasis.

Insulin is secreted as proinsulin which gets broken down to proinsulin which in turn generates the c-peptide and the A and B chains of insulin. Because the c-peptide is cleared more slowly than insulin, it is a useful marker of insulin secretion and allows discrimination of endogenous and exogenous sources of insulin<sup>3</sup>.

Sahay et.al, Singh S et.al showed significant reduction in FBG and PPBG levels in Type 2DM patients. The possible mechanism may be direct rejuvenation of cells of pancreas due to abdominal stretching during yoga, which may increase utilization and metabolism of glucose in peripheral tissues, liver and adipose tissues through enzymatic process<sup>7,8</sup>. Yoga increases parasympathetic/vagal control of the heart and reduces sympathetic activation via decreased stress levels, as well as reduces systemic inflammation<sup>9</sup>. This leads to reduced cardiovascular risk. The study conducted by Gordon et.al showed therapeutic, preventive

and protective effects of yoga on diabetes mellitus by decreasing oxidative stress and improving antioxidant status<sup>10</sup>. Our study also is in accordance with the previous studies done to show the significant reduction in FBG and PPBG.

Significant reduction in serum insulin and c-peptide levels found in this study shows increased insulin sensitivity. As c-peptide is formed alongwith insulin, it is a useful marker of endogenous insulin secretion and reduction in its levels showed improved insulin sensitivity. Studies done by Singh et.al, Chhaya et.al also showed reduction in serum insulin levels<sup>11,12</sup>. Sahay et al observed a significant increase in insulin sensitivity and decrease in insulin resistance by reporting a significant rise in the number of insulin receptors following yogic intervention.

The different studies previously done had reported decrease in the body fat and increase in lean body mass in type 2 diabetic patients after yogic intervention. Yoga helps in the redistribution of fat by reduction of fat from waist, thus changing from central obesity to peripheral obesity due to change in insulin resistance<sup>7</sup>. The decrease decrease in weight and BMI reported in our study also helps in reduction of obesity which is an important cause of insulin resistance (Table 3).

### Conclusion:

As per our study yoga may be beneficial to the patients of Type 2 DM in terms of better glycemic, physiological and psychological control as well as improvement in these. So, to conclude it can be postulated that yoga can be used as an adjunct to the conventional drug therapy for the treatment of Type 2 DM.

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The medal of the Nobel Assembly at the Karolinska Institute represents the Genius of Medicine holding an open book in her lap, collecting the water pouring out from a rock in order to quench a sick girl's thirst.

The inscription reads:

***Inventas vitam juvat excoluisse per artes***

loosely translated "And they who bettered life on earth by their newly found mastery."  
(Word for word: inventions enhance life which is beautified through art.)

The words are taken from Vergilius Aeneid, the 6th song, verse 663;

*Lo, God-loved poets, men who spake things worthy Phoebus' heart;  
and they who bettered life on earth by new-found mastery*

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