

## COMPARATIVE STUDY TO ASSESS THE ROLE OF YOGA PRACTICE ON BLOOD GLUCOSE LEVELS OF DIABETES MELLITUS TYPE 2 PATIENTS IN TERTIARY CARE INSTITUTION, TIRUPATI.

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### ABSTRACT

**Introduction:** Diabetes mellitus is plausibly one of the earliest diseases known to mankind. Effect of yoga as an intervention in the treatment of diabetes mellitus varies widely. While many researchers conceptualize yoga as a form of physical activity others argue that yoga is a holistic intervention incorporating body postures (asanas), breathing techniques (pranayamas), meditation, cleansing, modification of attitudes and behavior and mental discipline.

**Materials and Methods:** A Comparative study was conducted among Diabetes Mellitus Type 2 patients visiting the endocrinology outpatient department in a tertiary care institution in Tirupati. The study group consists of 30 patients who were practicing yoga and the control group consists of 30 patients who were not practicing yoga. Data collection was done by questionnaires on the sociodemographic profile, diabetic history, yoga practice, and their blood glucose levels (fasting blood glucose, post prandial blood glucose) were recorded before and after the study period.

**Results:** The blood glucose levels in the study group were lower when compared to those of the control group both before and after the study period. In our study yoga is not taken as an intervention, but the comparison was done between yoga practicing and not practicing groups.

**Conclusions:** Yoga is effective in controlling blood sugar levels in patients with type 2 diabetes mellitus, it can be practiced as an adjuvant to conventional treatment with anti-diabetic medication.

**KEY WORDS:** Diabetes Mellitus, Yoga, Blood Sugar.

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### INTRODUCTION

Diabetes mellitus is plausibly one of the earliest diseases known to mankind. About 3,000 years ago it was reported in Egyptian manuscript [1]. Diabetes mellitus is a chronic progressive metabolic disorder characterized by hyperglycemia mainly due to absolute (Type 1 diabetes

mellitus) or relative (Type 2 Diabetes Mellitus) deficiency of insulin hormone [2].

Type 1 diabetes mellitus or insulin dependent diabetes mellitus (IDDM) is due to insulin deficiency caused by autoimmune destruction of B cells in pancreatic islets and usually occur in children. Type 2 diabetes mellitus or non-in

sulin dependent diabetes mellitus (NIDDM) is characterized by deregulation of insulin release from the B cells along with insulin resistance in peripheral tissues [3,4].

According to IDF (Indian Diabetes Federation) 2015 estimates globally 415 million people are suffering from diabetes and this figure may reach up to 642 million in 2040 [3]. Currently 78.3 million people with diabetes are in South-east Asia region & this may rise up to 140.2 million in 2040 if proper measures are not taken [3]. India has the 2<sup>nd</sup> largest population (69.2 million) with diabetes in the world after China (109.7 million) [3].

The characteristic features of diabetes mellitus are polyuria, polydipsia and weight loss in spite of polyphagia, hyperglycemia, glycosuria, ketoacidosis and coma. The complications of diabetes are diabetic retinopathy, diabetic neuropathy, diabetic nephropathy, atherosclerosis which increases the risk of stroke, myocardial infarction [4].

Diabetes may result due to a genetic, environmental and behavioral interactions. It was observed that prevalence of diabetes was almost 3 times higher in individuals with sedentary lifestyle compared to those having physical activity (23.2% vs 8.1%) [5].

Effect of yoga as an intervention in the treatment of diabetes mellitus varies widely. While many researchers conceptualize yoga as a form of physical activity others argue that yoga is a holistic intervention incorporating body postures (asanas), breathing techniques (pranayamas), meditation, cleansing, modification of attitudes and behavior and mental discipline [6].

Abdominal stretching during yoga exercise causes rejuvenation or regeneration of cells of pancreas increasing the utilization and metabolism of glucose in peripheral tissues, liver and adipose tissues through enzymatic process [7,8]. Improved blood supply to the muscles enhances insulin receptor expression causing increased glucose uptake and thus reducing blood sugar [9]. Yoga postures can lead to improvement in the sensitivity of the B cells of the pancreas to glucose signal and also the improvement in insulin secretion [10].

The advantages of yoga as an option for physi-

cal activity in diabetes include

- The holistic philosophy in which physical exercises are linked to a wider lifestyle package that also includes diet, relaxation and stress management.

- Low cardiovascular demands compared to other forms of exercise.

- Low impact, hence meets a need for people who are obese or who have difficulties in mobilization [6].

#### **Aims and Objectives:**

1. To study the potentials of yoga therapy as an aid to the management of Diabetes Mellitus Type 2.

2. To study the sociodemographic profile of the known diabetic patients attending the tertiary care institution.

3. To identify the yoga practicing diabetic patients in the institution.

4. To compare the blood glucose levels between yoga practicing and not practicing diabetic patients.

#### **MATERIALS AND METHODS**

A Comparative study was conducted among Diabetes Mellitus Type 2 patients visiting the endocrinology outpatient department in a tertiary care institution in Tirupathi. Prior permission was taken from the Ethical Committee of the tertiary care institution. 60 patients who were satisfying the inclusion and exclusion criteria were taken as sample.

**Inclusion criteria:** Diabetes Mellitus Type 2 patients, Age > 35 years, Duration of diabetes more than one year.

**Exclusion criteria:** Type 1 diabetes. Pregnancy, Diabetic patients with other comorbid conditions like hypertension, congestive heart disease. Patients who are on treatment with insulin. Any medical condition that limits physical activity. Based on practicing yoga they were placed under two groups, study group and control group. The study group consists of 30 patients who were practicing yoga and the control group consists of 30 patients who were not practicing yoga. Informed consent was taken from all the 60 patients before collecting the data. Data collection was done by questionnaires on the sociode-

demographic profile, diabetic history, yoga practice, and their blood glucose levels (fasting blood glucose, post prandial blood glucose) were recorded before and after the study period.

**Blood glucose estimation:**

Blood sugar estimation was done by Glucose Oxidase Peroxidase method. Waist circumference, Hip circumference, Waist-Hip ratio and BMI were measured as per the standard methods.

**RESULTS**

**The other variables in the data collected were:**

**Variables:**

**Background variables:** Age, gender, occupation, socioeconomic status

**Dependent variables:** FBS (Fasting blood sugar levels), PPBS (Post prandial blood sugar levels)

**Independent variables:** Predisposing factors, risk factors like smoking, alcoholism, obesity and yoga etc.

**Table 1:** Characteristics of patients (number and %)

Parameter	Category	N		Group				p-value*
				Non-Yoga		Yoga		
Sex	Male	36	(0.6%)	16	(44.4%)	20	(55.6%)	0.29
	Female	24	(0.40%)	14	(58.3%)	10	(41.78%)	
Age	40-50	23	(38.30%)	12 (52.27%)		11 (47.8%)		0.3
	51-60	25	(41.60%)	10 (40%)		15 (60%)		
	Above 60	12	(20%)	8 (66.67%)		4(33.33%)		
Occupation	Profession	6 (10%)		4	(66.7%)	2	(33.3%)	0.01
	Semi-profession	12 (20%)		2	(16.6%)	10	(83.3%)	
	Farmer, Business	11 (18.30%)		9	(81.8%)	2	(18.2%)	
	Unemployed (retired/housewife)	31(51.6%)		15	(48.4%)	16	(51.6%)	
SES	Upper class	27	(45%)	9	(33.3%)	18	(66.7%)	0.08
	Upper middle class	26	(43.33%)	16	(61.5%)	10	(38.5%)	
	Middle class	3 (5%)		1	(33.3%)	2	(66.7%)	
	Lower middle class	4 (6.6%)		4 (100%)		0 (0%)		
Smoking	Yes	6 (10%)		4	(66.7%)	2	(33.3%)	0.38
	No	54	(90%)	26	(48.1%)	28	(51.9%)	
Alcohol	Yes	7 (11.6%)		4	(57.1%)	3	(42.9%)	0.68
	No	53	(88.30%)	26	(49.0%)	27	(51.0%)	
Medication	Glimepiride	23(38.3%)		10	(43.5%)	13	(56.5%)	0.51
	Metformin	19	(31.67%)	9	(47.4%)	10	(52.6%)	
	Combination (2 or more)	18	(30%)	11	(61.1%)	7	(38.9%)	

\* by Chi-square test of independence; p < 0.05 is significant.

**Table 2:** Group wise statistics of variables (Mean ± S.D).

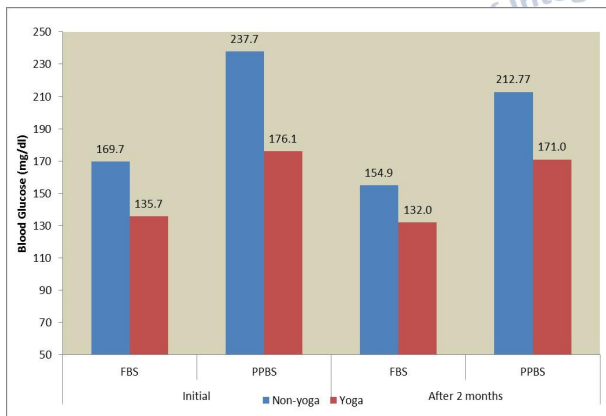
Variable	Group		p-value#
	Non Yoga	Yoga	
Age (Years)	54.93 ± 8.87	53.27 ± 7.53	0.436
Current Height(in cm)	162.56 ± 6.97	162.78 ± 7.97	0.911
Current Weight(in kg)	67.43 ± 9.90	69.59 ± 11.47	0.438
SBP(in mmHg)	120.93 ± 9.93	122.47 ± 8.51	0.523
DBP(in mmHg)	79.27 ± 6.37	79± 6.40	0.872
BMI(in kg/m2)	25.4 ± 3.16	25.94± 3.43	0.532
Waist Circumference(in cm)	93.8 ± 10.41	90.77± 7.29	0.197
Hip circumference(in cm)	114.37 ± 10.74	111.2± 8.43	0.209
Waist/Hip ratio	0.81± 0.03	0.81± 0.03	0.991
FBS-initial value(mg/dl)	169.7± 62.68	135.7 ± 27.88	0.01
PPBS-initial value(mg/dl)	237.7± 89.31	176.1 ± 32.92	0.001
FBS-after 2 months(mg/dl)	154.9± 50.36	132.03 ± 16.80	0.024
PPBS-after 2 months(mg/dl)	212.77± 76.82	171.03± 21.79	0.007

# unpaired t-test for group means

Variable	Group		p-value <sup>#</sup>
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**Table 3:** Paired Comparison of FBS and PPBS within each group.

**Figure 1:** Mean Blood Glucose level in different groups.



**Statistical Analysis:** All the 60 patients were divided into Yoga and Non-yoga groups with 30 in each group. The calculations were performed using MS-Excel and IBM SPSS 20.0 version.

The baseline characteristics and distribution of patients by demographic variables was shown in Table-1. Chi Square test shows no significant difference between the Yoga and Non-yoga groups except in the case of occupation where majority of semi-professionals and unemployed were found to be active in Yoga.

Table-2 shows the group wise descriptive statistics for continuous variables (both demographic and clinical characteristics). Unpaired t-test was used to compare the mean values between the Yoga and Non-yoga groups and no significant difference in demographic characteristics was found between the groups. However, both FBS and PPBS have shown significant mean difference between Yoga and Non-yoga groups initially as well as after 2 months. Patients of

the Yoga group were found to have lower FBS and PPBS means, when compared with Non-yoga groups.

It can be seen from Table-1 that the mean FBS and PPBS were uniformly lower in the Yoga group than the Non-yoga group. However the Coefficient of Variation (CV = sd/mean x100) which was a measure of internal inconsistency of value shows that in all the four instances the CV was much higher in Non-yoga group than Yoga group.

In the Non-yoga group the CV for FBS at initial and after 2 months gap were 36.9% and 32.5% respectively, where as in the Yoga group these values were 20.5% and 12.7% respectively. This shows that the FBS in the Non-yoga group was relatively more unstable than the Yoga group.

Similarly in the Non-yoga group the CV for PPBS at initial and after 2 months gap were 37.5% and 36.1% respectively, where as in the Yoga group these values were 18.7% and 12.7% respectively. This shows that the PPBS in the Non-yoga group was relatively more unstable than the Yoga group.

The pre-post comparison of FBS and PPBS in each group was shown in Table-3. Paired t-test had shown no significant difference in the Yoga group after two months of observation. However in the Non-yoga group there was a significant decrease (p<0.05) in both FBS & PPBS. In terms of effect, the fall in FBS for Non-yoga and Yoga groups were 8.7% and 2.7% respectively. In the case of PPBS these values were 10.4% and 2.9% respectively.

Figure 1: shows the changes in the blood glucose levels in Non-yoga and Yoga groups at two points of observation.

## DISCUSSION

Diabetes mellitus has become a leading public health issue globally. The global prevalence of diabetes among adults over 18 years of age has been risen from 4.7% in 1980 to 8.5% in 2014. In 2015, an estimated 1.6 million deaths were directly caused by diabetes. Another 2.2 million deaths were attributable to high blood glucose in 2012 [19].

Our study was conducted among 60 type 2 diabetes patients of which 30 were practicing yoga practicing yoga and the other 30 were not practicing yoga. Here we have not introduced yoga as an intervention; the yoga group was practicing yoga previously. All the subjects in yoga group have not practiced same yoga asana and also they have been practicing yoga for variable durations. They had started practicing yoga after being diagnosed with diabetes, before our study.

In the paired samples statistics p values are not significant in yoga group, this is because as we have not introduced yoga as an intervention. As they were practicing yoga previously their blood glucose levels are at lower extremes and thus after 2 months the fall in blood glucose levels is less.

The glycaemia control was better in the yoga practicing group when compared to the non yoga practicing group.

The exact mechanisms underlying the apparent beneficial effects of yogic intervention on diabetes risk profiles are not well understood. The possible mechanisms are as follows:

Various yogic intervention may be directly rejuvenating cells of pancreas as a result, of which there may be increase in utilization and metabolism of glucose in the peripheral tissues, liver and adipose tissues through enzymatic process [18].

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 [18].

The proposed psychologic mechanisms of yoga practice and reduction of sympathetic nervous system reactivity, with associated decreases in accumulated stress and activation of the parasympathetic response through vagal nerve stimulation with associated elevation of mood states and inhibition of negative neuro endocrine response [21].

Yoga is reputed to affect all areas of life, whether practiced on a regular basis for health promotion or embraced as a way of life. Yoga practice has demonstrated a positive effect on flexibility, musculoskeletal stability, range of motion and pain associated with musculoskeletal disorders [21].

Diabetes-related benefits of physical activity include improvements in psychologic and clinical markers such as insulin resistance, glycemic control, hypertension, atherogenic dyslipidemia, fibrinolytic and endothelial function, oxidative stress, regulation of bodyweight, body fat %, and waist/hip ratio [21].

Conventional medicine for individuals with diabetes has been geared toward regulating blood glucose with a combination of dietary modification, insulin and/or oral agents, maintaining ideal body weight, exercising regularly and self-monitoring blood sugar [22]. Regular practice of yoga establishes natural harmony and functional balance between various organ systems, leading to better health and a feeling of wellbeing [23].

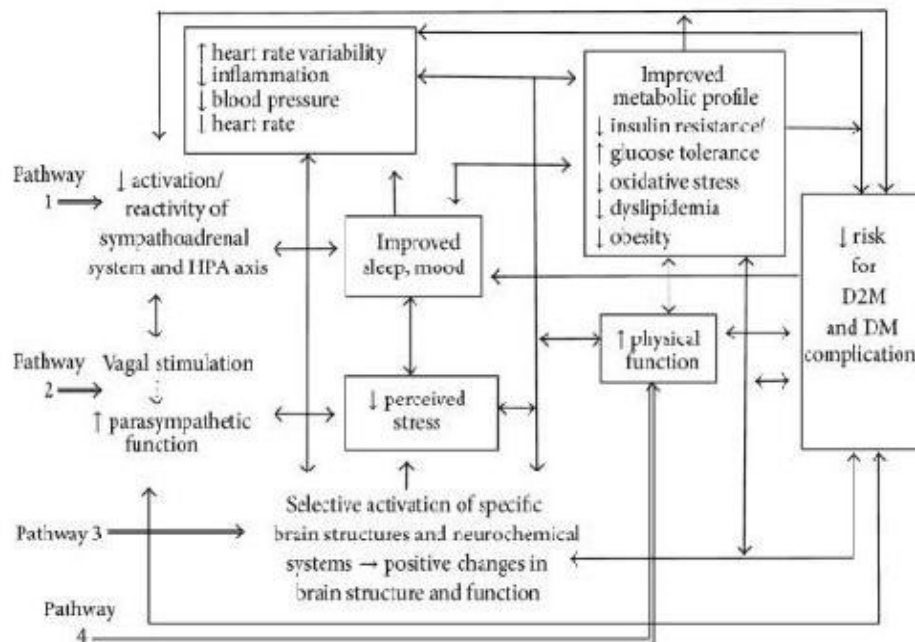
In the study done by SubhashManikappa Chimkode [16] there is significant decrease in blood glucose levels after yoga in both the groups (diabetic and non-diabetic) indicating potential role of yoga in preventive and management strategies for Diabetes Mellitus Type 2.

Yoga therapy helps in decreasing the medication. In the study done by Madanmohan [15] they stated that one participant who didn't practice yoga at home reported that there was an increase in her medication while the one who practiced yoga every day at home reported that her medication had reduced.

Yoga not only decreases the blood glucose levels but also Low Density Lipid (LDL) and increases the High Density Lipid (HDL). This was

confirmed in many studies as in the studies done by Santwana Mondal [18]; V.Malhotra [17]; Rani K Beena [23]; Sahay B [24].

**Fig. 2:** possible mechanisms by which yoga practices may influence outcomes in those with and at risk for type 2 diabetes [20].



### Summary:

We have conducted a comparative study in a tertiary care institution at Tirupathi, consisting of 60 Diabetes Mellitus Type 2 patients. Among them 30 patients who were not practicing yoga were taken as control group and 30 patients who were practicing yoga were taken as study group. The patients blood glucose levels were evaluated before and after the study period of 2 months and the values were compared between study group and control group. The blood glucose levels in the study group were lower when compared to those of the control group both before and after the study period. But the fall in blood glucose levels within the study group is less when compared to the fall in the control group. In our study yoga is not taken as an intervention, but the comparison was done between yoga practicing and not practicing groups.

Yoga is effective in controlling blood sugar levels in patients with type 2 diabetes mellitus, it can be practiced as an adjuvant to conventional treatment with anti-diabetic medication.

### CONCLUSION

Diabetes mellitus type 2 is now a leading cause of death and disability which can be managed by lifestyle modifications, in particular yoga therapy is effective in promoting health and

management of diabetes and yields many benefits with very few adverse effects.

Yoga as an adjuvant in the treatment of type 2 diabetes mellitus is effective in improving glycemic control in patients with type 2 diabetes mellitus.

Yoga is an ancient discipline designed to bring balance and health to the physical, mental, emotional, spiritual dimensions of the individual. A comprehensive yoga therapy program has the potential to enhance the beneficial effects of standard medical management of diabetes mellitus and can be used in an effective complementary or integrative therapy program.

The improvement in various biochemical indices and stress reduction by practicing yoga can enable a person with a better healthy living.

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