



## EFFECT OF YOGA ON GLYCAEMIC LEVEL: A PILOT, RANDOMIZED, COMPARATIVE STUDY BETWEEN WALKING AND YOGA IN ADULT MALE WITH TYPE 2 DIABETES MELLITUS

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### Abstract

**Introduction:** About 80% of type 2 diabetes is either preventable or controllable by changing diet, increasing physical activity and improving the living environment. The present study was aimed to ascertain and compare the effect of brisk walking and yogic exercise on the glycaemic level of adult male with type 2 diabetes mellitus. **Methodology:** A total of 20 diabetic patients were asked to carry out either yoga or brisk walking based on the randomization for 15 consecutive days for 1 hour daily between 6 am and 7 am with an empty stomach. Blood glucose level of the study participants was measured using calibrated glucometer about 10 minutes prior to treatment on the first day (Baseline) and after treatment on the 15<sup>th</sup> day. **Results:** Blood glucose level of participants has been reduced from its baseline at the end of 15<sup>th</sup> day in both brisk walking and yogic exercise. However yoga group shows significant post treatment blood glucose reduction ( $p < 0.0458$ ) than the brisk walking group ( $p < 0.4505$ ) at 90%, and 95% confidence level. **Conclusion:** The findings conclude that yogic exercises have enhanced the blood glucose lowering capacity along with pharmacological treatment and may be practiced as adjuvant therapy for Type 2 diabetic population to reduce or prevent long term complications. However, the results of the pilot study needs to be validated by a pivotal study.

**Keywords:** Yoga, Blood Glucose, Type 2 Diabetes Mellitus, Brisk Walking.

### Introduction

Diabetes is one of the major causes of premature illness and death worldwide. The prevalence of diabetes in adult was estimated to around 285 million (6.4%) in 2010 and the number is expected to grow 439 million (7.7%) by 2030. India has the world's largest diabetes population with 50.8 million, followed by China with 43.2 million. Adult diabetes is expected to increase about 69% in developing countries and 20% in developed countries which may be due to population growth, aging, urbanization, increasing prevalence of obesity, physical inactivity and hereditary nature of the disease. Type 2 diabetes accounts for about 85-95% of all diabetes in high income countries and even higher percentage in low and middle income countries. Diabetic research across the globe has confirmed that uncontrolled diabetes leads to diabetic related complications either acute or chronic which increases the burden, cost of the treatment and finally results in premature death. About 80% of type 2 diabetes is either preventable or controllable by changing diet, increasing physical activity and improving the living environment. Physical activity includes brisk walking which is the most widely recommended physical activity for people with diabetes. Brisk walking increases the blood sugar utilization by muscles which help in controlling weight which in turn can reduce health risks.

Other form of physical activity includes yoga which is being practiced all over the world and has established beneficial effects on human. Many clinical researches have suggested that the yoga may be as effective as or better than exercise in improving a variety of health related outcome measures including heart rate variability, blood glucose, blood lipids, salivary cortisol, oxidative stress, fatigue, pain, and sleep both in healthy and unhealthy populations. The present study was aimed to ascertain and compare the effect of brisk walking and yogic exercise on the glycaemic level of adult male with type 2 diabetes mellitus (1 & 3).

### Methodology

This descriptive observational study was carried out prospectively for the period of 15 consecutive days. A total of 20 diabetic patients who met all inclusion criteria and none of the exclusion criteria were included in the study.

### Inclusion Criteria

Male diabetic patients above 18 years of age, who are medically eligible for brisk walking and yogic exercise (Certified by Qualified Physician) were included in the study.

### Exclusion Criteria

Diabetic patients below 18 years of age, mentally retarded, differently-abled and females were excluded from the study.



### Data Collection Form

The data were collected using a well-designed 'Data Collection Form' organized under four sections (Table I).

**Table I: Organization of Data Collection Form**

Section	Contents
1	Brief introduction about the study, procedure planned on the participant and written informed consent
2	Demographic data of diabetic patients
3	Disease status
4	Study related data entry

### Study Design

Enrolled participants were allotted identification number based on first come first serve basis and were equally divided into two groups (Group 1: Walking group and Group 2: Yoga group) based on randomization. The study protocol was explained to the participants and written informed consent was obtained from each participant prior to study related activities. The study participants were trained under the guidance of a certified yoga teacher to carry out yoga (which are listed in Table II) the day prior to start of the study. The study participants were asked to carryout either yoga or brisk walking based on the randomization for 15 consecutive days for 1 hour daily between 6 am and 7 am with an empty stomach. Blood glucose level of study participants were measured using calibrated glucometer about 10 minutes prior to treatment on the first day (Baseline) and after treatment on the 15<sup>th</sup> day. Participants were requested to continue their pharmacological treatment as scheduled daily.

**Table II: Treatment of Yoga Group**

S.No.	Yogic Exercises
1	Pawanmuktasana (Hip and back muscles stretching)
2	Surya Namaskar (Dynamic stretching of the muscles of the abdomen, back, neck, hands and legs)
3	Ardha Mastyendrasana (Twisting the spine)
4	Bhujangasana (Exercises the lower back muscles)
5	Dhanurasana (Exercises the whole back and muscles)
6	Paschimottanasana (Hamstring stretch)
7	Salabhasana (Good exercise for the abdomen)
8	Uttanpadasana (Exercises all the muscles in the abdominal region, both internal and externally)
9	Yogamudra (Pressure on the lower abdomen and back stretch)
10	Shavasana (Muscle relaxation)

### Study Hypothesis and Statistical Analysis

The hypothesis set prior to the start of the study was 'Yogic exercise significantly reduces the blood glucose level along with pharmacological treatment than the brisk walking'. The hypothesis was tested using t test (Designed by Dr. C.E. Efstathiou, Department of Chemistry, National and Kapodistrian University of Athens, Greece) at 90%, 95% and 99% confidence level.

### Results

All the 20 participants completed the study and none of them withdrew consent till the end of the study. Data collected from 20 diabetic patients were compiled, analyzed and discussed below. Table III reveals participant's general information.

**Table III: SUMMARY OF PARTICIPANT'S GENERAL INFORMATION**

Age (in years)	Number of Patients (Percentage)
18-30	02 (10.00 %)
31-40	11 (55.00 %)
41-50	07 (35.00 %)
Diabetic since (in years)	Number of Patients (Percentage)
< 01	5 (25.00 %)
> 01-02	1 (05.00 %)



> 02-03	2 (10.00 %)
> 03-04	4 (20.00 %)
> 04-05	4 (20.00 %)
> 05-10	3 (15.00 %)
> 10-20	1 (05.00 %)
<b>Blood Glucose Level (in mg/ml)</b>	<b>Number of Patients (Percentage)</b>
> 120-150	1 (05.00 %)
> 151-175	5 (25.00 %)
> 176-200	5 (25.00 %)
> 201-250	1 (05.00 %)
> 251-300	8 (40.00 %)

Around 90% of the participants were between the ages of 31 and 50 years and 40% of the participants had been diagnosed with diabetes around 3-5 years before. Baseline blood glucose level of around 50% participants was between 151-200 mg/dl.

#### Effect of Brisk Walking and Yogic Exercise on Blood Glucose Level

Blood glucose level of participants has been reduced from its baseline at the end of the 15<sup>th</sup> day in both brisk walking and yogic exercise (Table IV).

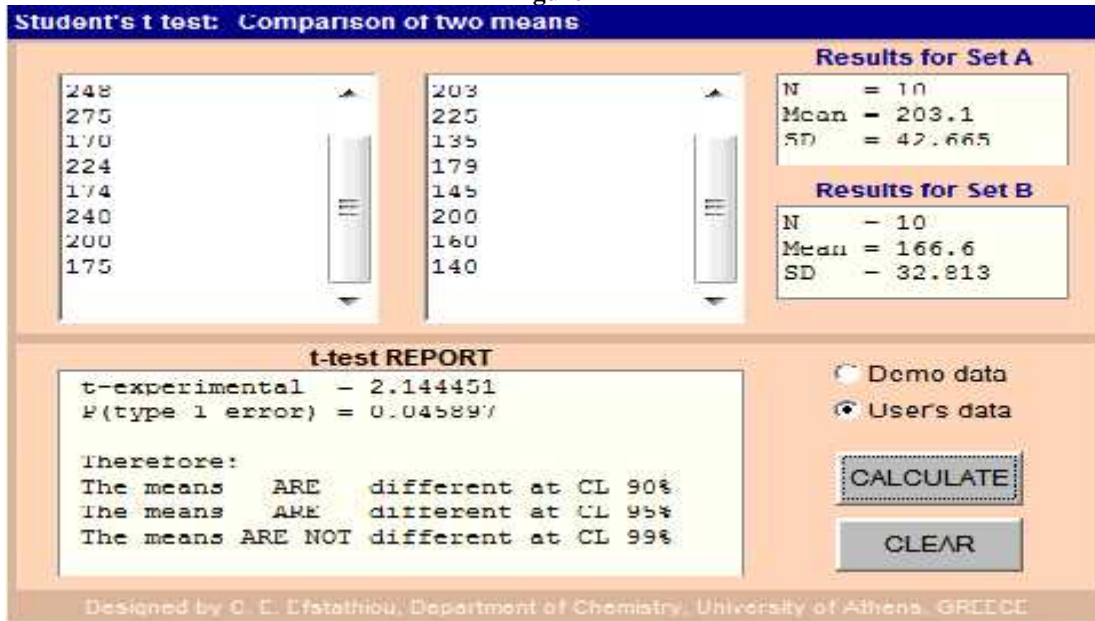
**Table IV: Summary of Acute Effect of Brisk Walking and Yogic Exercise on Blood Glucose Level**

Participant Identification Number	Group	Blood Glucose Value (in mg/dl)		P Valve
		Pre-Treatment	Mean Post Treatment	
01	Brisk walking	148	140	0.450528
03	Brisk walking	195	179	
04	Brisk walking	179	165	
05	Brisk walking	261	240	
09	Brisk walking	181	163	
11	Brisk walking	291	263	
12	Brisk walking	293	271	
14	Brisk walking	187	168	
15	Brisk walking	284	263	
16	Brisk walking	296	270	
02	Yoga	155	139	0.045897
06	Yoga	162	140	
07	Yoga	248	203	
08	Yoga	275	225	
10	Yoga	170	135	
13	Yoga	224	179	
17	Yoga	174	145	
18	Yoga	248	200	
19	Yoga	200	160	
20	Yoga	175	140	

However, the yoga group shows significant post treatment blood glucose reduction [(p =0.0458), (p < 0.05), (Figure 1)] than the brisk walking group [(p = 0.4505), (p > 0.05), (Figure 2)] at 90%, and 95% CL.

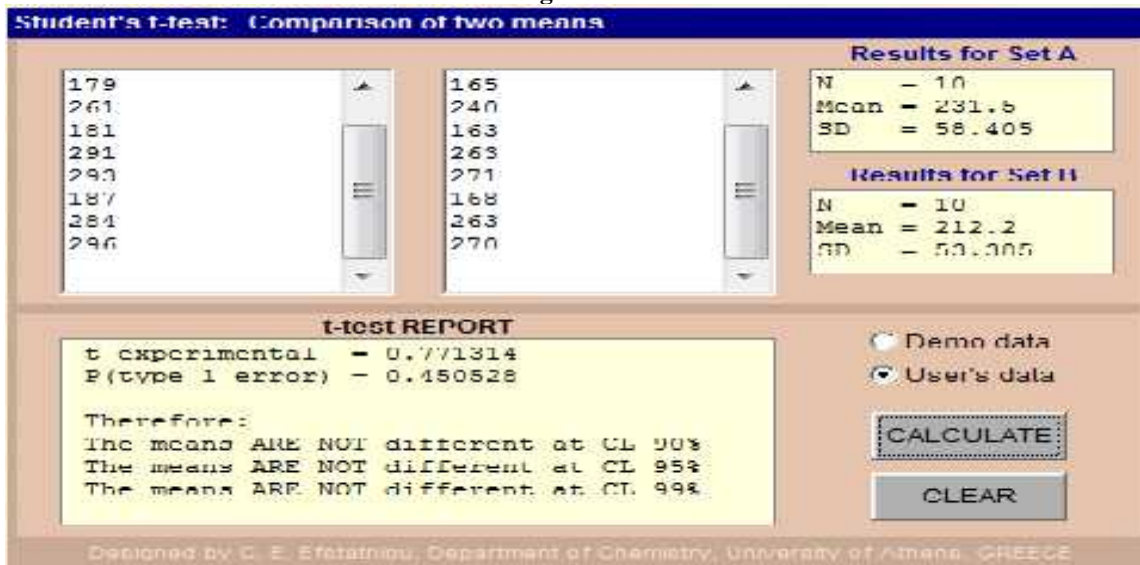


Figure 1



T Test between Pre and Post treatment of yoga group

Figure 2



T Test between Pre and Post treatment of brisk walking group

**Discussion**

Pharmacological interventions along with lifestyle modifications may be required to maintain normoglycemia and prevention of diabetic complications. Diet and physical activities are the most recommended life style modification for type 2 diabetes mellitus.

Life style modification includes brisk walking, diet and yoga. However, during brisk walking, muscles utilize the availability of excess glucose in blood and burns out excess calories which may substantially reduce the blood glucose level and provide a chance to decrease the complications of uncontrolled type 2 diabetes. However, brisk walking for an hour may not be possible for many diabetic patients due to age and non availability of favorable environment in cities.

Yogacharya B.K.S Iyengar, the world's greatest living yoga master has included a group of 28 different yogic asanas in his book "Light on Yoga", which under proper guidance would give relief to diabetes. Many international studies have reported the beneficial effect of the practice of yoga on diabetes. The basic mechanisms by which yoga reduces the blood glucose



level are listed in Table V. The study hypothesis was accepted as the yogic exercises significantly reduce the blood glucose level along with pharmacological treatment than the brisk walking.

**Table V: Mechanism of post treatment blood glucose reduction by yogic exercise**

S.No.	Mechanism Of Action
1	Abdominal contraction and relaxation produced by various yogic postures on the pancreas has a direct influence on pancreatic secretion by rejuvenation of the pancreatic cells.
2	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
3	Yogic postures reduce adrenaline, noradrenalin and cortisol in blood, which are termed as stress hormones which in turn decreases the glucagon secretion and possibly improving insulin action.
4	Yogic postures reduce both blood pressure and cholesterol levels which plays a significant role in development of diabetic and related complications.
5	Weight loss induced by yoga is a well accepted mechanism

### Conclusion

The findings conclude that yogic exercises have enhanced the blood glucose lowering capacity along with pharmacological treatment and may be practiced as adjuvant therapy for Type 2 diabetic population to reduce or prevent long term complications. However, the results of pilot study needs to be validated by a pivotal study.

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