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Effect of Yogasanas on Glycemia and Insulinemia

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Abstract:
Back ground: *Diabetes mellitus type 2 is considered to be largely preventable and treatable through Yoga.*
Aim: *To study the effect of yogasanas on blood glucose and serum insulin and to consider whether yogasanas increases the insulin sensitivity to the glucose signal.*
Methods &Material: *This is a cross-sectional study done in Naturopathy hospital. Group I consists of 30 healthy subjects and group II of 18 subjects who were known diabetics. Every subject performed sets of asanas for 6 consecutive mornings each from Monday to Saturday for 4 weeks. Blood glucose was estimated in the fasting state and 30 minutes after a carbohydrate load, at the start of the study and 4 weeks after performing Yogasanas for 30 healthy subjects. For the 18 diabetic subjects only fasting blood glucose was estimated before and 4 weeks after performing yogasanas.*
Results: *Fasting blood glucose after the asanas were reduced. Fasting serum insulin in diabetics were significantly lower after the asanas than before. HOMA index is significantly reduced after the asanas than before, with the p value of < 0.01, both in healthy and in diabetic subjects*
Conclusion: *This study suggests that performance of asanas lead to increased sensitivity of the beta cells to the glucose signal.*
Keywords: *Asanas, Beta cells, Diabetes mellitus, HOMA Index, Serum insulin.*

I. Introduction

Diabetes mellitus poses a major health problem globally and is one of the five leading causes of death in most developed countries. [1] Diabetes is defined as a state of reduced insulin action due to its decreased availability or effectiveness in varying combinations, as per J.I. Bell and T.D.R. Hockaday[2] India has the maximum increase during the last few years. The WORLD HEALTH ORGANIZATION has estimated that in 1995, 19.4 million individuals were affected by diabetes in India and these numbers are expected to increase to 57.2 million by the year 2025 i.e. one-sixth of the world total. The received figures are 80.9 million by the year 2030.[1] Among this 'diabetes epidemic' the prevalence of type 2 diabetes due to Insulin resistance accounts for over 85% of diabetes worldwide and is closely linked to industrialization and increasing life expectancy.[3] Insulin resistance may be due to insulin antibodies in circulation, a decrease in insulin receptors or antibodies to insulin receptors.[4] It is also called the silent killer because most diabetics don't even know they have the disease.[5]The uncontrolled levels of blood sugar, over a period of time, may cause damage to the vital organs, such as the heart, kidneys, eyes and brain.[6]

Several studies suggest that insulin resistance is present much before metabolic abnormalities are manifested. While researchers have found effective ways of controlling diabetes, conventional medicine has not been able to come up with a permanent cure for diabetes. Currently, diabetes is considered to be largely preventable and treatable through Yoga. Yoga's effectiveness at preventing and treating diabetes is due to its emphasis on healthy diet and lifestyle as well as its ability to balance the endocrine system, massage and tone the abdominal organs, stimulate the nervous and circulatory systems and to reduce stress.[7] Regular practice of Yoga does reduce blood sugar levels, blood pressure, weight, the rate of progression and the severity of complications.[8] The symptoms are also reduced to a great extent while high levels of blood glucose in diabetes are harmful, a sudden drop in blood glucose levels can be disastrous as well. One major advantage of Yoga over conventional medicine and therapeutic techniques is its holistic approach.[9] One of the causes of Insulin resistance is obesity. Obesity and diabetes are also termed as twin epidemics.[10] Yoga life style will be most suitable to facilitate treatment for this twin epidemic. Some specific asanas like dhanurasana, halasana, bhujangasana and pavanamuktasana have been identified to have a greater effect on the control of diabetes than other asanas. Asanas are based on a sound knowledge of human anatomy and physiology, stimulating specific nerves, organs and glands.The asanas are based on five principles.

i) The use of gravity to increase the flow of blood to the desired part of the body.
ii) Organ massage : The position of the asana causes a squeezing action on a specific organ or gland, resulting in the stimulation of that part of the body.
iii) Stretching muscles and ligaments : This increases the blood supply to the muscles and ligaments as well as relaxing them. It also takes pressure off nerves in the area.

iv) Deep breathing : While holding the yoga posture, breathing is done slowly and deeply, moving the abdomen only. This increases the oxygen supply to the target organ or gland, thereby enhancing the effect of the asanas.[11]

Hence this study is taken up mainly in healthy subjects to examine the hypothesis that yogasanas increase beta cell sensitivity and decreases insulin resistance, thereby help in the treatment of diabetes mellitus. Exercise is another important determinant of insulin sensitivity. Inactivity is associated with down-regulation of insulin sensitive kinases and also increases the accumulation of Free Fatty Acids within skeletal muscle.

Sedentary people are therefore more insulin resistant than active people with the same degree of obesity. Moreover, exercise leads to non-insulin dependent glucose uptake into muscle, reducing the 'demand' on the pancreatic beta cells to produce insulin.

II. Materials And Methods

This study was done in subjects, attending Keep Fit Hospital for Naturopathy treatment. The study group consists of 30 healthy subjects (15 males, 15 females) in the age group 20-50 years, who were not having risk factors like hypertension, diabetes mellitus, Bronchial asthma, cardiovascular disease or other endocrine disorders. All of them were non-smokers and non-alcoholics and none of the female subjects were pregnant. None of them were on drugs like steroids. They also had no family history of diabetes mellitus or obesity. These 30 individuals were included in the study group who voluntarily came for performing Yogasanas for physical wellbeing. This study was undertaken after getting their consent for doing laboratory tests and for performing yogasanas for four consecutive weeks.Another group of 18 subjects (11 males and 7 females) in the age group of 30-60 years were selected, who were known diabetics and all of them were on oral hypoglycemic for years. None of them were hypertensive and did not give history of any other disease. None of them were receiving injectable insulin preparations. All of them had come voluntarily for performing Yogasanas.The standing height and weight of the subjects were measured by using standard methodology with the help of inch tape in centimeters and weighing machine.

Body mass index was calculated : (1) ($BMI = Wt \text{ in } kg / Ht \text{ in } m^2$)

During the 4 week duration, every subject performed the following sets of asanas for 6 consecutive mornings each from Monday to Saturday.Breathing exercises-5 min, Stretching exercises-10 min, Asanas-15 minutes(Dhanurasana, Halasana, Vajrasana, Bhujangasana)With an interval of 1 min between the asanas.Shavasana (Corpse pose): 5 min

Blood glucose levels were estimated in the fasting state and 30 minutes after a carbohydrate load, 75 g of oral glucose at the start of the study and 4 weeks after performing Yogasanas for 30 healthy subjects. For the 18 diabetics subjects only fasting blood glucose was estimated before and 4 weeks after performing yogasanas.

2.1Blood Glucose:

Serum concentration of glucose was estimated by glucose oxidase method using kits obtained from Isotope laboratory services, Madurai. The intra assay and inter assay coefficients of variation for blood glucose were 2.1 % and 4.0 % respectively.

2.2Oral glucose tolerance test:

After collecting, fasting venous blood sample 75 g glucose was dissolved in 300 ml of water and the drink is given to the subject orally and 2 ml of venous blood sample was taken after 30 minutes interval.Normal glucose tolerance as per guidelines by National Diabetes Data Group (NDDG) for interpreting OGTT is

a) Fasting value < 115 mg / dl (venous plasma) or < 100 mg / dl (venous blood)
b) The ½ hour, 1 hour or 1 ½ hr values < 200 mg / dl (venous plasma) or < 180 mg / dl (venous blood)

Serum Insulin was also estimated in the same blood sample. Fasting and after 30 min OGTT in healthy subjects before and 4 weeks after performing yogasanas. In the 18 diabetic subjects, Serum insulin was estimated in the fasting blood before and 4 weeks after performing yogasanas.

2.3Estimation of Serum Insulin :

Serum Insulin was estimated by the ADVIA centaur Insulin assay in the Isotope laboratory, Palam station road, Goripalayam, Madurai.

2.4Assay Priciple :

The ADVIA Centaur Insulin assay is a two site sandwich immuno assay using direct chemi luminescent technology which uses constant amounts of two antibodies. The first antibody, in the Lite Reagent, is a monoclonal mouse anti-insulin antibody labelled with acridinium ester. The second antibody in the solid phase is a monoclonal mouse anti insulin antibody, which is covalently coupled to paramagnetic particles.The

system automatically performs the following steps.Dispenses 25 ml of sample into a cuvette,dispenses 50 ml of Lite reagent and incubates for 5 minutes at 37^{o}C,dispenses 250 ml of solid phase and incubates for 2.5 minutes at 37^{o}C,separates, aspirates and washes the cuvettes with reagent water,dispenses 300 ml each of Acid Reagent and Base Reagent to initiate the chemi luminescent reaction,reports results according to the selected option.A direct relationship exists between the amount of insulin present in the sample and the amount of relative light units (RLUs) detected by the system.

2.5Homeostatic model assessment (HOMA) The approximating equation for insulin resistance using fasting blood sample, derived by the use of the insulin – glucose product, divided by a constant.

:(2) HOMA Index = Fasting Blood Glucose x Fasting Serum Insulin⁄405 where glucose is given in mg/dl and Insulin is given in µu/ml.This model has supported the view that insulin resistance is significant in patients with type 2 Diabetes Mellitus.

III. Results

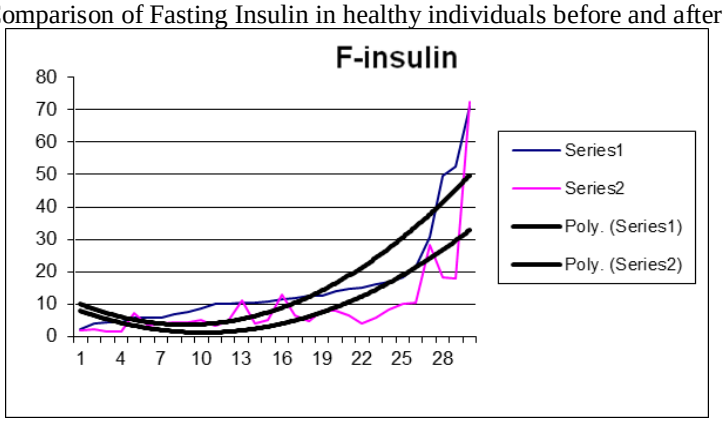
TABLE 1 Comparison of variables in healthy individuals before and after asanas

Contents	Before Asanas		After Asanas		P value
	Mean	S.D	Mean	S.D	
Fasting B.S.	81.87	7.25	84.03	9.73	0.1050
Fasting Insulin	15.89	15.64	9.51	13.21	0.0002
½ GTT Sugar	116.47	15.64	119.33	13.21	0.5
½ GTT-Insulin	22.04	21.56	29.77	22.74	0.0131
Homa Index	3.27	3.26	1.95	2.81	0.0002

TABLE 2 Comparison of variables in diabetic subjects before and after asanas

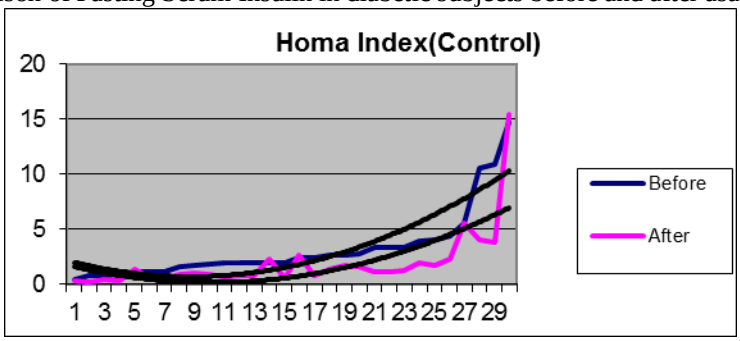
Contents	Before Asanas		After Asanas		P value
	Mean	S.D	Mean	S.D	
Fasting Blood sugar	160.28	51.51	152.22	47.13	0.2144
Fasting Insulin	30.36	16.39	20.82	14.93	0.0017
Homa Index	12.18	7.42	8.18	7.72	0.0028

Fig. 1 Comparison of Fasting Insulin in healthy individuals before and after asanas



From the line diagram depicted it is obvious that the fasting serum insulin levels after the asanas were significantly lower than those before the asanas in healthy subjects.

Fig2 Comparison of Fasting Serum Insulin in diabetic subjects before and after asanas



The results of fasting serum insulin in diabetics were significantly lower after the asanas than before. P value is also significant.

Fig 3 Comparison of HOMA index in healthy individuals before and after asanas

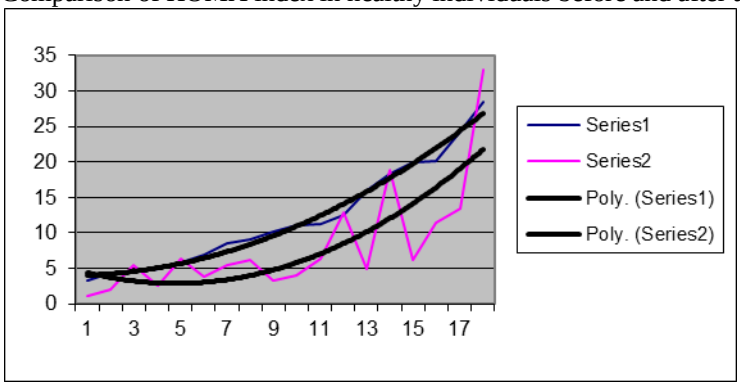
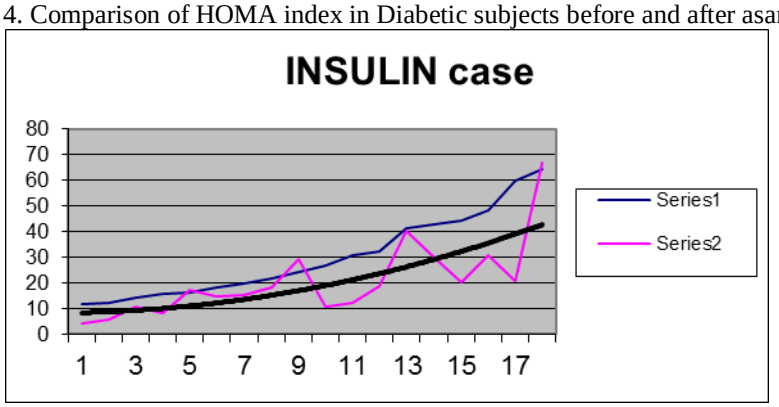


Fig 4. Comparison of HOMA index in Diabetic subjects before and after asanas



HOMA index is significantly reduced after the asanas than before, with the p value of < 0.01, both in healthy and in diabetic subjects.

IV. Discussion

According to the present study, Fasting serum insulin levels were significantly lower after the asanas than before the asanas both in healthy and diabetic subjects. Further post prandial serum insulin 0.5 h after ingestion of 75 g glucose was significantly higher after the asanas than corresponding value in the OGTT performed before the asanas in healthy subjects. Also the HOMA index for insulin resistance is significantly lowered after the asanas than before in both healthy and diabetic subjects. These observations suggest that the performance of asanas led to increased sensitivity of the beta cells of pancreas to the glucose signal.

Both in vivo (Devlin et al, 1987)[12] and in vitro studies (Soman et al 1979)[13] have demonstrated the ability of exercise to increase insulin sensitivity. Low intensity exercise such as Yogasanas has been shown to be as effective as high intensity exercise in enhancing the same (Braun et al, 1995)[14]. Conversely studies of (King et al, 1988)[15] also show that individuals confined to bed rest for 7 days have an increase in their level of insulin resistance. A study conducted by Manjunatha S et al[11], the serum insulin levels within 10 minutes of performing a variety of asanas were not higher than those before the asanas, suggesting that there is no evidence for release of insulin from the pancreas as a result of performing the asanas. As per the study conducted by (Dela F et al, 2004)[16] the enhanced insulin sensitivity after asanas is a progressive long term effect of asanas and not an acute effect and it is irrespective of the type of asanas done since the set of asanas were done in a random sequence.In the present study, there is no significant difference in the blood glucose levels in both fasting and 0.5 h after 75g oral glucose before and after the asanas in healthy individuals. In the diabetic subjects, with higher fasting blood glucose there is mild reduction after the asanas but not statistically significant. Performance of asanas in the fasting state was presumably accompanied by steady and accelerated utilization of glucose, but serum glucose did not fall significantly after the asanas. The reason possibly was that the beta cells responded to accelerated glucose utilization with prompt decrease in insulin release. On the other hand, administration of 75g glucose led to a prompt increase in insulin release in amounts greater than under similar circumstances before the subject had been initiated into any asanas. Thus the increased sensitivity of beta cells to glucose seems to work in both ways reducing insulin release briskly when glucose level tends to fall and increasing insulin release sharply when glucose level tends to rise.

A study undertaken by (Viswanathan V et al in 2005)[17], showed how performing Yogasanas can be considered not as adjunct but as an alternative method to treat diabetes by comparing two comparable groups,

one group received only metformin drug and the other group did yogasanas. (Jain et al, 1993)[18], studied the response patterns of people with type 2 diabetes to Yoga therapy. Their study showed 70% of the participants to have a fairly good response to yoga therapy. After 40 days of Yoga, there was a significant reduction in hyperglycemia measured by fasting blood glucose and oral glucose tolerance. Exercise is another important determinant of insulin sensitivity. Inactivity is associated with down-regulation of insulin sensitive kinases and may also increase the accumulation of FFAs within skeletal muscle. Sedentary people are therefore more insulin resistant than active people with the same degree of obesity. Moreover, exercise allows non-insulin dependent glucose uptake into muscle, reducing the 'demand' on the pancreatic beta cells to produce insulin.

Yogic practices have been shown to reduce base line and average glucocorticoid levels. But the glucocorticoid response to an acute challenge is enhanced. These findings indicate a lower level of stress and an enhanced capacity to cope up with a challenge. Certain asanas have been shown to reduce the fasting blood glucose and serum cholesterol levels. These are favorable biochemical indicators suggesting reduced risk of diabetes and atherosclerosis.

V. Conclusion

In this study, the effect of Yogasanas over a period of 4 weeks on Blood glucose and serum insulin levels were compared. This study has shown a significant reduction in the fasting serum insulin levels after the asanas ($p< 0.01$) than those before the asanas. Also there is a significant lowering of insulin resistance, indicated by a reduction in HOMA index both in healthy and diabetic subjects. Blood glucose levels before and after the asanas in the diabetic subjects were mildly reduced though not significantly lowered. Thus this study supports the previous studies that performance of asanas as a long term effect, led to increased sensitivity of the beta cells of pancreas to the glucose signal and it is irrespective of the type of asanas done.

Although a variety of physical exercises are known to enhance the peripheral sensitivity to insulin, low intensity exercise such as yogasanas, (at 50% of maximal oxygen consumption) has been shown to be as effective as high intensity exercise (75% of maximal oxygen consumption) in enhancing the same. Hence Yogasanas help in the prevention and treatment of diabetes mellitus especially NIDDM. Primary or secondary prevention of diabetes through life style intervention alone is a natural way of preventing type 2 diabetes in India since the increased incidence and prevalence of disease are mainly due to the adoption of a sedentary life style and excessive food intake. Non pharmacological approach is not only rational with the current knowledge of risk factors for type 2 diabetes, but this approach can also reduce the risk of atherosclerotic vascular disease, which is common in type 2 diabetes. On an average, each kilogram of weight loss increases life expectancy by 3-4 months. Since most of the diabetic patients in India are in productive years of life i.e. 45-65 age group, non pharmacological approach through Yoga, will be very rewarding to the society.

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