

ORIGINAL RESEARCH

A Cross Sectional Prospective Study to Evaluate the Effect of Yoga on Blood Sugar and Body Mass Index (BMI) Values for Different Time Durations of Yoga Training at Tertiary Care Center

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ABSTRACT

Background: Yoga asanas and pranayama can control the blood sugar in a cost-effective manner, as there is no requirement of any sophisticated equipment with maximum space or fitness classes. The aim of this study to evaluate the effect of Yoga on blood sugar and body mass index (BMI) values for different time durations of Yoga training at tertiary care center.

Materials & Methods: A cross sectional observational study done on 200 subjects of both the genders in the age group 20-50 years were performed in the Department of physiology and Lala Lajpat Rai Memorial (LLRM) Medical College, Meerut, U.P., India during one year period. Subjects performed asanas supervised by primary investigator, in sitting, standing and lying position for 45 minutes daily, five days a week. Each asana was performed for 3 repetitions and the end position of each repetition was hold for 30 seconds. Purak and Rechak (deep breathing) was coordinated with the different posture of every asana. Thirty seconds rest period was given between each asana. Cool down was done with Shavasana for 5 minutes. Appropriate descriptive and implemented statistics were carried out using SPSS (Statistical Package for Social Sciences) version 22.0 software.

Results: Our study showed that 62% of participants were between 41-50 years among males and 92% of participants between 31-50 year's in females. Both male and female participants showed a negative correlation between the blood sugar level and yoga performance. Also, a negative correlation existed between the BMI and their yoga performance. Positive correlation is seen between the blood sugar levels and BMI values in both genders.

Conclusion: Yoga cannot cure diabetes but keeps a beneficial check on blood sugar values. Hence yoga is more of cost effective, does not need any equipment as in exercise, it can be done within four walls with adequate ventilation and long term effect of this yoga can explore the beneficial effects on glucose and other hormonal homeostasis, insulinsensitivity, it can improve cognition, and keep the body in shape

with a sense of well-being.

Keywords: Yoga, Diabetes mellitus, BMI, Blood sugar, Obesity, Pre-diabetic.

INTRODUCTION

Diabetes Mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia.¹ Chronic hyperglycemic state presents with disturbances of carbohydrate, protein and fat metabolism, occurs either due to inadequate secretion of insulin (a hormone which control blood glucose level and prevents hyperglycemia) or when the body cannot effectively use the insulin produced by beta cells of the pancreatic islets.² In the modern world diabetes being a life style ailment affects the people who are stripped of any physical activity and adopt a life which is against the nature.³ In India, it is estimated that nearly 79 million people may suffer from diabetes by the year 2030⁴, when compared to the existence of 1 million people in the year 2000 with diabetes.⁵

Diabetes is of two types - type 1 and type 2- former attributable to the pancreatic gland aetiology by the auto immune manner which completely fails to secrete the hormone insulin 1 subsequently, type 2 diabetes is due to the complex interaction of genetics, behavioral, and environmental factors which ends in insulin resistance.⁶ Nevertheless type 1 diabetes is generally a manageable disorder, the existence of type 2 diabetes is usually a preventable one.⁶ In this era, the incidence of diabetes and its complication has been obsolete from our hands, the resolution of the primordial prevention for diabetes is solicited.⁷

Pre-diabetes, a condition termed as a phenotypic intermediate hyperglycemia has a higher plasma glucose level within the normoglycemic state and for the prevention of diabetes, the control of pre-diabetes is mandatory.⁸ The epidemiologic consideration implies that subjects with pre-diabetes owe a 4 % to 6 % annual risk for succession to type 2 diabetes⁹, and conveys that the small sensory fibre neuropathy occurs as a complication with the prediabetic status.¹⁰

Obesity occurring due to excess accumulation of body fat has a constitutional effect on insulin resistance which mainly couples with the type 2 diabetes by certain unknown factors.¹¹ Obesity being a solitary imminence for pre-diabetes, controlling the obesity by life style changing measures are compelled for the control of pre-diabetes.

The change in sedentary life habits by means of exercise and yoga can reduce the occurrence of pre-diabetes. Nevertheless, sympathetic nervous system activation by means of exercise increases the plasma catecholamines¹², the yoga asana which activates the parasympathetic system can make the body fit, calm the mind and pave way for a stress-free wellbeing.¹³

Even though yoga existed in the world from 3000 BC, in recent days only its practice has been increased. The word 'Yoga' means 'yoke' in Sanskrit which inferred harnessing oneself in a disciplined way.¹⁴ The science of yoga includes various physical postures, breathing control techniques, relaxation and regulation of the mind via meditation. The slow, static, stretch exercise by means of yoga asanas⁴, ensures that, the down regulation of the hypothalamic- pituitary – adrenal axis (HPA) gearshifts the sympathetic nervous system¹⁵ which are extensively triggered by the stressors to the mind and body, towards the parasympathetic nervous system.¹³ The yogic postures can increase the insulin sensitivity by revitalising the pancreatic beta cell activity.⁴

Any form of exercise can decrease the centripetal obesity⁵, but the disciplined way of yoga practice causes overall weight loss,¹⁵ lighten the stress¹⁶ and reduction in free fatty acid levels which partakes a beneficial effect on beta cell function by decreasing the lipotoxicity effect.¹⁷ Furthermore, the meditative practices can slow the cellular aging, improve the epigenetic changes, increase the insulin secretion and mitochondrial function¹⁸, by the way of rapid gene expression modality.¹⁹ Thus, the short term²⁰ and long-term yoga practice can yield a check on lean body mass²¹ and bring down blood sugar within normal range.

Yoga asanas and pranayama can control the blood sugar in a cost-effective manner, as there is no requirement of any sophisticated equipment with maximum space or fitness classes.²² The aim of this study to evaluate the effect of Yoga on blood sugar and body mass index (BMI) values for different time durations of Yoga training at tertiary care center.

MATERIALS & METHODS

A cross sectional observational study done on 200 subjects of both the genders in the age group 20-50 years were performed in the Department of physiology and Lala Lajpat Rai Memorial (LLRM) Medical College, Meerut, U.P., India during one year period. Patients were excluded who have any kind of systemic disease & who will give not written consent.

Methodology

Equal number of males (N=100) and females (N=100) were included in this study. They were explained about the procedure orally, and the study was carried out after getting the informed written consent. The subjects who were all attending the master health checkup unit and non-communicable disease department of age 20-50 years of both sexes were selected to assess their body mass index for overweight and obesity.

The subjects were advised to wear light clothing's and asked to stand erect with their arms at their sides in relaxed position with both bare feet close together. Portable standard weighing scale machine was used, weight in kilograms was measured.

By using a stadiometer, the vertical height of the subjects was measured in centimetres by asking the subject to stand erect.

BMI of the Subject: -

Body mass index was calculated using the Quetelets Index

$BMI = \text{Body weight (Kg)}/\text{Height}^2 \text{ (M)}$

- All overweight and obese individuals with BMI more than 23 were selected for the study.
- All participants were screened for pre-diabetic status.

Prediabetic Status Screening:

According to American Diabetes Association guidelines, the cut off range for impaired plasma glucose level was determined

- Fasting blood sugar – 100-125 mg /dl
- Random blood sugar / OGTT – 140 -199 mg /dl
- Hb A1C (Glycosylated haemoglobin) - 5.7% - 6.4%

After selecting the overweight and obese individuals with prediabetes, they were instructed to do YOGIC exercises under strict supervision.

Yoga Session:²³⁻²⁸

Subjects performed asanas supervised by primary investigator, in sitting, standing and lying position for 45 minutes daily, five days a week. Asanas carried out in Sitting: Paschimottanasana and Gomukhasana. Asanas carried out in Standing: Trikonasana and Virbhadrasana. Asanas carried out in Lying: Bhujangasana, Pavanmuktasana, Dhanurasana, Setubandhasana and Shavasana. Each asana was performed for 3 repetitions and the end position of each repetition was hold for 30 seconds. Purak and Rechak (deep breathing) was coordinated with the different posture of every asana. Thirty seconds rest period was given between each asana. Cool down was done with Shavasana for 5 minutes.

Statistical Analysis

Appropriate descriptive and implemented statistics were carried out using SPSS (Statistical Package for Social Sciences) version 22.0 software.

RESULTS

Our study showed that 62% of participants were between 41-50 years among males and

92% of participants between 31-50 year's in females (table 1).

The participant's blood sugar and BMI values after the regular yoga training for 40 days, at 3 month and after 6 months were assessed. The mean blood sugar values reduced from 118.56 mg/dl to 103.24 mg/dl, 93.77 mg/dl & 87.32 mg/dl respectively in male which showed a statistically significant ($P < 0.001^*$). Among the females participants mean blood sugar values reduced from 114.23 mg/dl to 105.90 mg/dl, 90.64 mg/dl & 85.86 mg/dl respectively which was statistically significant ($P < 0.001^*$) (table 2).

Regarding the participants BMI values, among male subjects the mean BMI reduced from 26.55 kg/m^2 to 25.72 kg/m^2 after 40 days, 23.68 kg/m^2 at 3 months and 22.82 kg/m^2 at 6 months which showed a paired t test value as 5.434. The female subjects BMI values reduced from 26.28 kg/m^2 to 25.67 kg/m^2 , 23.34 kg/m^2 and 22.55 kg/m^2 with paired statistical significant at comparison of base line value (table 3).

Both male and female participants showed a negative correlation between the blood sugar level and yoga performance. Also, a negative correlation existed between the BMI and their yoga performance. Positive correlation is seen between the blood sugar levels and BMI values in both genders.

Table 1: Age wise distribution of study participants

Age groups	Male	Female	Total
21-30 yrs	4	4	8
31-40 yrs	34	46	80
41-50 yrs	62	46	108
51-60 yrs	0	4	4
Total	100	100	200

Table 2: Gender wise trend of blood sugar level after starting yoga

Blood sugar (mg/dl)	Male		Female	
	Mean±SD	P- value (Comparison with base line)	Mean±SD	P- value (Comparison with base line)
At base line	118.56±6.94	-	114.23±7.12	-
After 40 days	103.24±9.96	<0.001*	105.90±8.64	<0.001*
At 3 months	93.77±10.23	<0.001*	90.64±9.23	<0.001*
At 6 months	87.32±5.63	<0.001*	85.86±4.66	<0.001*

Table 3: Gender wise trend of BMI (kg/m^2) after starting yoga

BMI (kg/m^2)	Male		Female	
	Mean±SD	P- value (Comparison with base line)	Mean±SD	P- value (Comparison with base line)
At base line	26.55±1.12	-	26.28±0.98	-
After 40 days	25.72±1.36	<0.001*	25.67±0.99	<0.001*
At 3 months	23.68±1.06	<0.001*	23.24±0.96	<0.001*
At 6 months	22.82±0.67	<0.001*	22.55±0.54	<0.001*

DISCUSSION

The present study involves the effect of yoga on BMI and blood sugar level among the 200 overweight and obese subjects. BMI and blood sugar were checked at 0 day (baseline), 40 days, 3 months, 6 months of their regular yoga asanas and significant

changes in blood sugar and BMI values were noted.

After 40 days of yoga practice, there was a reduction in both mean blood sugar and BMI values among the study participants. This is similar to the study conducted by Viveka P. Jyotsna et al²⁹, in those 40 days regular yoga practice showed a reduction in blood sugar values along with an improved mental wellbeing. A study conducted by Nidhi Gupta et al³⁰, showed a measurable improvement in anxiety score by daily practice of yoga and relaxation techniques which was achieved by ten days of training of yoga. Thus, yoga keeps a check on sympathetic over activity, which in turn controls the stress.

The study conducted by Shirley Telles et al³¹ revealed a great reduction in body mass index, waist and hip circumferences, mid arm circumference, total cholesterol in a 6 day residential yoga and vegetarian diet program and also showed an increased postural stability and bilateral hand grip strength. In the present study, yoga programme was not residential and there was no compulsion of dietary changes but, advised a low fat, low caloric and plant-based diet. Though the participants started the yoga practice with their own diet plan, by doing regular yoga and relaxation techniques, within 2 months, half of them adopted to a strict vegetarian diet, and there was a gradual reduction in BMI. A study conducted by Shirley Telles et al³¹ showed that practicing yoga for 5 hours, with a high fibre vegetarian diet reduced the BMI of obese persons. This shows that the practicing of yoga along with strict vegetarian diet could have a greater impact on BMI.

In the present study, following 3 months of yoga practice, there was a drastic reduction in both BMI and mean blood sugar level in both genders. Even in the 41-50 years age group subjects, showed moderate flexibility while doing yoga irrespective of their BMI. The study conducted by K. Vaisali et al³², also showed similar reduction in BMI levels for doing 12-week duration of yoga asana and pranayama. They also exhibited significant decrease in glycosylated haemoglobin (HbA1c), fasting glucose level, total cholesterol, low density lipoprotein along with increased high-density lipoprotein (HDL) values and found to have a great improvement in hand grip strength among study participants. Similarly, study conducted by Viveka P et al²⁹, showed the beneficial result of yoga on blood sugar level in an 8-week yoga programme. Study by Subhash Manikappa et al⁴ revealed that practicing yoga for about 3 months showed a statistically significant reduction in fasting and post prandial blood sugar levels comments that yoga could rejuvenate or regenerate the pancreatic beta cells.

With continued yoga practice of 3 and 6 months, the mean blood sugar values attained normal which showed a statistically significant value in our study. The study conducted by Neena Sharma et al³³, showed a similar result of reduced blood sugar and BMI values along with normalization in glycosylated haemoglobin and improved haemoglobin level. This shows that long term practice of yoga will have a beneficial effect on body weight and blood glucose level as it increases the insulin sensitivity. Another study reviewed by Tiffany Field et al³⁴ revealed that long term practice of yoga, not only has influence on blood sugar and BMI values, but also alleviates depression, anxiety and pain syndromes like low back ache, osteoarthritis, rheumatoid arthritis conditions. The yoga group participants at the end of 24 weeks had a greater improvement on spinal flexion, spinal extension, right lateral flexion, left lateral flexion when compared to the control group.

Thus, 40 day of regular yoga practice along with 3-6 months of consistent follow-up have shown controlled blood sugar and reduced body mass index, which was similar with the study conducted by Dhinesh Kumar et al²², in which the yoga classes were 5 session a week for about 2-week duration and have shown a positive effect on blood sugar and BMI. It has been postulated that the sedentary life style which leads on to excess accumulation of body fat results in overweight and obesity which finally lands up with

prediabetes. The study conducted by Ian J Neeland et al³⁵ among the white obese population found that adipose tissue dysfunction which was characterised by ectopic fat deposition in the abdominal viscera is associated with dysregulation of the inflammatory adipokines and insulin resistance which provided an important mediator for prediabetes with full-blown diabetes. Another study conducted by Irina G. Obrosova et al¹⁰ in an animal model (high fat diet fed mice) revealed that the high fat diet leads on to obesity with neuropathy which itself is a complication of pre diabetes status. Key metabolic abnormalities seen in neuropathy was found to be accumulation of sorbitol and fructose on nerves (sciatic nerve) due to increased activity of sorbitol pathway in glucose metabolism rather than increased blood glucose level. In addition to this, oxidative stress to the cell and activation of poly (ADP-ribose) polymerase activation which is responsible for deranged DNA or cell death might be a causative factor for neuropathy.³⁶

The obesity and overweight persons with prediabetic status have been selected for yoga training in the present study with the aim to prevent the occurrence of diabetes and its complication by changing the sedentary life style behaviour. In current epidemiology, changing the sedentary lifestyle behaviour is really a challenge to the society, as the modern life style is having a tendency to decrease the voluntary physical activity and increase dietary fat intake. The above said fact is well correlating with the study explained by Thorkild et al³⁶. Similarly the study conducted by D.W Dunstan et al³⁷ revealed the relationship between television viewing time and mortality outcome which was found to be linear due to sedentary life style associated chronic illness and also given that there was a statistically significant relation seen between television viewing time and obesity.

Yogis living up to a very gold age attribute their longevity to the benefits of regular practice of yoga and pranayama, which keeps the circulatory and respiratory system to be fit, makes the muscles strong, maintains the tone and posture with perfection in blood glucose level and haematological profile. Yoga gives a natural and healthy way to achieve body and mind fitness³⁸, thus providing a solution to face the internal environmental stress by down regulating the effect on both the sympathetic nervous system / hypothalamo pituitary adrenal axis (SNS/HPA).

Modernization and exacerbation of work stress may be contributors to prediabetes. With the mindfulness of positive effects of yoga on cardio- respiratory, physical, metabolic and mental health, many people are motivated towards the practice of yoga and it can be availed as a supplementary to the people with sedentary life elegances, work stress, increased body weight and hyperglycaemic conditions. Hence, yoga can be used as adjuvant therapy for prediabetes as it improves the mind and body with a sense of well-being.

CONCLUSION

Yoga cannot cure diabetes but keeps a beneficial check on blood sugar values. Hence yoga is more of cost effective, does not need any equipment as in exercise, it can be done within four walls with adequate ventilation and long term effect of this yoga can explore the beneficial effects on glucose and other hormonal homeostasis, insulin sensitivity, it can improve cognition, and keep the body in shape with a sense of well-being.

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