RESEARCH ARTICLE

EFFECT OF YOGA ON GLYCEMIC PROFILE IN DIABETICS

Neena Sharma, Neeru Gupta
Department of Physiology, Government Medical College, Jammu, Jammu & Kashmir, India

Correspondence to: Neena Sharma (vijay3137@rediffmail.com)

DOI: 10.5455/ijmsph.2014.020720141 Received Date: 10.06.2014 Accepted Date: 02.07.2014

ABSTRACT

Background: Yoga is a holistic health system that forms a part of Ayurvedic medicine. Yoga is described as physical and mental technique that can be effectively used to create physical and mental well-being. Since its introduction into modern culture, yoga has enjoyed a tremendous growth in popularity as an adjunct to healthy living. The purpose of yoga is to achieve highest level of integration through the control of the modification of mind, experience enduring health and happiness, and improve the quality of life. All yogic practices are complementary to each other and their nature is psycho-neuro-physical. Yoga *asanas* cover the entire human anatomy, from the top of the head to the tips of toes. The *asanas* are of two types – active *asanas* tone specific muscles, nerve groups and activate brain cells; passive *asanas* are employed in meditation, relaxation and *pranayama* practices. Regular practices of *asanas* correct systemic and postural irregularities. The greatest benefit from practicing *asanas* comes when we learn how to relax in a given posture, rather concentrating the mind, totally focused on a single object. It is different and unique in comparison to conservational exercise because it is performed with spiritual aim, positive attitude, preceded by purification of thoughts, parasympathetic nervous system and subcortical brain predominance. Psychological stress and faulty lifestyles are the contributors of the diseases of modern civilization such as obesity, hypertension, diabetes mellitus and coronary artery disease. Yoga begins by working with the body on a structural level and the yogic practices balance all the system of the body. The end result is increased mental clarity, emotional stability, a sense of overall well-being and activation of neuro-hormonal mechanisms that bring about health benefits.

Aims & Objectives: The present study was conducted to examine effect of long-term yoga practice on glycemic profile, glycated haemoglobin and normal haemoglobin in diabetics.

Materials and Methods: Experimental group comprised 120 diabetic patients, 60 for yoga and 60 without yoga. Subjects were practicing yoga for more than two years and controls did not practice yoga at all. Subjects with acute macrovascular complications, pulmonary tuberculosis and rheumatoid arthritis were excluded from the study. Both, subjects and controls, had complete drug compliance throughout the study period.

Results: The mean value of fasting blood glucose level was less than that of controls and difference in the mean value as determined by unpaired 't' test was statistically significant. Similarly, the mean value of haemoglobin was greater and that of glycated haemoglobin was less in subjects, as compared to controls. Results revealed fall in fasting blood glucose level (p=.0001), fall in glycated haemoglobin (p=.0001) and increase in haemoglobin level (p=.0001) in yoga group. The regular practice of yoga brings changes in hematologic parameter, and therefore, it is recommended as a complementary therapy in diabetics.

Conclusion: Yoga can be used as an effective therapy in reducing blood glucose level and glycated haemoglobin in diabetics with simultaneous improvement in haemoglobin.

Key Words: Yoga; Glycated Haemoglobin; Diabetics

Introduction

Diabetes mellitus is a syndrome complex characterized by impaired carbohydrate, protein and fat metabolism. It is of two types: (a) insulin-dependent diabetes mellitus (IDDM), also called juvenile onset diabetes mellitus – it is below 20 years of age and is due to decrease in insulin secretion owing to viral infection, atrophy or degeneration of beta-cells of Langerhans of pancreas. Plasma insulin levels are low and intervention involves administration of long acting insulin, subcutaneously; (b) non-insulin-dependent diabetes mellitus (NIDDM), also called adult onset diabetes mellitus – it is seen above 30 years of age in middle-age group, characterized by normal secretion of insulin but decrease in sensitivity of peripheral tissue to the insulin. Plasma insulin levels are normal or even high and intervention involves dietary restriction, weight reduction and oral sulphonylureas that increase the number of insulin receptors and sensitivity of peripheral tissue to the insulin.

Yoga is a Sanskrit word meaning union. It is Hindu spiritual and self-discipline method for integrating the body, breath and mind. It is a tradition of health and spirituality that evolved in the Indian peninsula over a period of some 5000 years. History of yoga traditions starts with the yoga *sutra* written by Patanjali, a renowned yoga teacher and Hindu philosopher.

Yoga has now entered the Western mainstream through the work of Swami Vivekananda, who popularized oriental Hindu philosophy in the late 19th and early 20th centuries.

The yogic system of health involves the exercise of all types of muscles of the body *i.e.*, skeletal, smooth and cardiac with little expenditure of energy. The associated intra-thoracic and intra-abdominal pressure changes form the basis of yoga system of health. All yogic practices are complementary to each other and people of all ages can practice yogic exercises easily and effectively. The nature of yogic practices is psycho-neuro-physical. The main aim of yoga is to achieve highest potential and level of integration through the control of the mind.

Anyone, who practices yoga correctly, soon begins to appreciate the depth and breadth of its benefits, like relaxation and softening of deep inner tension and blockages, sense of body-mind equilibrium and feeling of energetic light heartedness.

Yoga is physical and mental exercise that aims at minimizing haematological, circulatory and respiratory health problems. It is an important element of Ayurvedic medicine *i.e.*, the science of life. Traditional yoga is a philosophy for living and is associated with a series of behavioural modifications that contribute to a healthy lifestyle.

Yoga is beneficial in the management of respiratory and circulatory health problems including stress, anxiety and depression. Recent research on yoga has confirmed that it has therapeutic effect in the treatment of chronic obstructive pulmonary disease, diabetes mellitus, low backache, stress-related psychosomatic disorders, coronary artery disease, gastrointestinal tract disturbances, postural defects and joint pain. Women subjected to psychological stress found significant improvement after three months yoga program.[1] In anxiety disorders, the effectiveness of yoga has also being proven.[2] The increase in thalamic GABA levels observed after yoga practice explains the improvement in anxiety disorder, depression and multiple sclerosis where lower GABA levels were found.[3]

Patients with chronic back pain are recommended yoga for its analgesic effect.[4] Yogic lifestyle in hot flushes, blood pressure, irritability and stress associated with menopause had led to the improvement in quality of life.[5]

Three months of yoga practice in patients suffering from chronic renal failure undergoing hemodialysis, raised the blood cell count by 11%, the haematocrit by 13%, pain by 37%, urea by 29% and creatinine by 14%.[6] However, there are certain risks of yoga practices, particularly in those individuals who are physically unfit or weak or when the yogic practices are not performed by them within strict limits of safety. The risks include musculoskeletal injury, arrhythmia, dehydration, fluctuation of hemodynamic parameters, thromboembolic phenomenon due to intimal tear resulting in stroke.

Today, yoga forms an important part of mind/body strategies to promote good health, which includes relaxation techniques, hypnosis, visualization, feedback, meditation, breathing exercises, cognitive behavioural therapy and spirituality.[7] These all strategies are based on researches into the connections between the nervous, immune and endocrine systems, all of which make up basis of psycho-neuro-endocrino-immunology.[8]

With the limited information available regarding glycemic profile in diabetics among yoga practitioners, the present study was undertaken to assess the influence of prolonged yoga practice of more than two years on glycemic profile in diabetic patients.

Materials and Methods

The present study was undertaken among diabetics. Experiment subjects were recruited from a yoga centre in Jammu city. Control subjects were selected from diabetic patients attending a diabetic clinic centre in Jammu city. Total subjects were grouped into 60 for yoga practitioners, and another 60 for controls. The subjects of both the groups were aged between 40 to 60 years. None of them was either alcoholic or smoker and subjects in the experimental group were practicing yoga for more than two years.

Subjects with acute macro-vascular complications, pulmonary tuberculosis, rheumatoid arthritis and those who were not able to perform yoga were excluded from the study. Compliance with the intervention therapy in the form of yoga was defined as attendance for at least four days a week at the yoga centre.

The eligibility criterion for controls was same as that of subjects but they were not yoga practitioners and did not believe in yoga. The diabetics had complete drug compliance throughout the study period. The experimental subjects were taking 1½ hour session for at least four times a week at a yoga centre. None of the subject engaged in any other out-of-routine physical activity.

Yoga Program

- The yogic exercises were learnt first and then performed.
- The exercise mat was used and room were well ventilated and clean.
- Yoga was done on an empty stomach in peaceful surroundings and clean simple dress was worn.
- All exercises were performed slowly, gently, smoothly and not to the point of exhaustion.
- The *asanas* were done with positive attitude *i.e.*, with the conscious awareness of spirituality.
- The best timing suggested was day break time *i.e.*, dawn, for yoga to be performed.
- It was performed every day for 1 ½ at the same time and at a fixed place.

The yoga program began with *Surya Namaskar* and continued with a series of *asanas* like *Tadasana, Padahastasana, Vrikshasana, Trikonasana, Vajrasana, Vakrasana, Gomukhasana, Paschimottanasana, Pawanamuktasana* and *Dhanurasana*.

Pranayama i.e., abdominal, thoracic and cervical breathing and *dhyana i.e.*, meditation, mental tranquillity, inner peace techniques accompanied these *asanas*.

Surya Namaskar, or salutation to sun, energies the neuro-glandular and neuro-muscular system of body and ensures balanced supply of oxygenated blood, thus strengthening entire psychosomatic system of human body. *Pada* means feet and *Hasta* the hands, thus *Padahastasana* increases the flexibility of spine and removes the extra fat from abdomen. *Vrikshasana* means tree posture, which improves coordination between body and mind.

Trikonasana, i.e. a triangular form, makes the spine flexible and removes the fat from abdomen. *Vajrasana* improves digestion and blood circulation along with strengthening the thigh muscles. *Paschimottanasana* means stretching of back, which improves the flexibility of spine and strengthens the back muscles. *Pawanmuktasana* removes gas from abdomen and abdominal fat. It also helps to get rid of constipation.

Dhanurasana is specific for diabetics as it is helpful to control blood sugar. The subject lies prone with face down on the floor and then arch back to hold the ankles with hands. The subject inhales while being arched and exhale while the prone position is reached. It provides blood circulation, strengthens abdominal muscles, removes constipation, maintains spine erect and controls the blood sugar level in diabetic patients.

Pranayama or breathing exercises and *asanas* work hand-in-hand to balance and integrate different physiological functions, and help to dissolve emotional blocks and negative habit patterns, that can obstruct the flow of vital energy within the body. It involves a slow deep breath (for about 6 minutes), involving predominant use of the abdominal musculature and diaphragm. The breath is held momentarily in full inspiration within the limits of comfort, and then slow and spontaneous exhalation is done. Again the respiration is held within the limits of comfort in full exhalation.

Blood Sampling

The blood sampling was done between 9.00 am to 10.00 am from a forearm vein of all the participants with fasting for more than eight hours. The haematological parameter, haemoglobin and glycosylated haemoglobin and biochemical parameter like fasting blood glucose were analyzed.

One ml of venous blood in an EDTA tube was taken. Haemoglobin and glycosylated haemoglobin were analyzed with automated haematology analyzer Sysmex K-1000, which is a fully automated qualitative haematology analyzer for *in-vitro* diagnostic use in clinical laboratories. It provides quick screening for haematological testing.

The biochemical analysis of fasting blood sugar was carried out by taking 2 ml of venous blood in biochemical tube and results were determined by automated analyzer.

Results

Table 1 depicts the age distribution of the subjects and controls. Maximum number of subjects was in the age group of 40 to 45 years and minimum number of subjects was in the age group of 56 to 60 years.

The mean value of blood glucose level of subjects was 132.63, and that of controls was 193.31. The difference between the mean value of blood glucose level determined by unpaired 't' test was statistically highly significant (p=.0001). The mean value of haemoglobin in subjects was higher (10.30) than that of controls (7.77) and the difference in the mean value was statistically

highly significant (p=.0001). The mean value of glycosylated hemoglobin in subjects was lower as compared to controls and the difference between the two was statistically highly significant (p=.0001).

Table-1: Age distribution of subjects and controls

Age (years)	Subjects (n=60) No. (%)	Controls (n=60) No. (%)
40 – 45	22 (36.7)	18 (30.0)
46 – 50	16 (26.7)	20 (33.3)
51 – 55	14 (23.3)	10 (16.7)
56 – 60	8 (13.3)	12 (20.0)

Table-2: Mean value of haematological and glycemic parameters of subjects and controls

Parameter	Subjects (n=60)	Controls (n=60)	p-value
Fasting blood glucose	132.63 ± 5.64	193.31 ± 5.36	0.0001**
Haemoglobin	10.30 ± 0.59	7.77 ± 0.16	0.0001**
Glycosylated haemoglobin	7.68 ± 0.81	8.99 ± 0.39	0.0001**

***Highly significant*

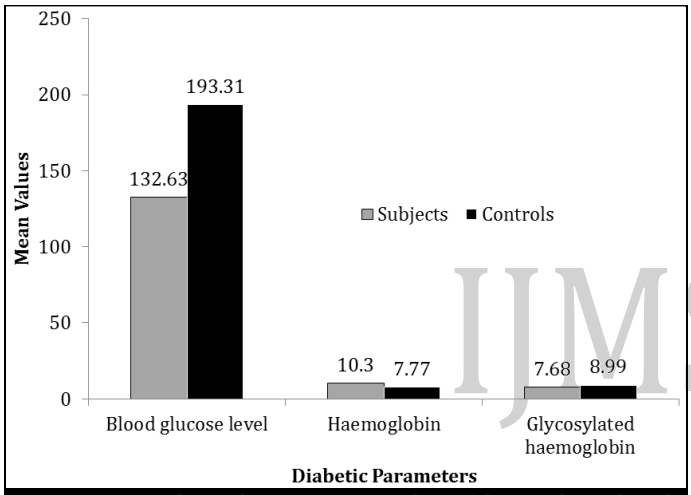

Figure-1: Bar chart showing mean value of hematological and glycemic parameters of diabetics

Discussion

Yogis living up to a very gold age attribute their longevity to the benefits of regular practice of yoga and *pranayama,* which maintains circulatory and respiratory health, muscle strength, tone, posture with improvement in blood glucose and haematological profile.

Yoga practice is natural and healthy way to achieve body and mind fitness and prevent the onset of disease. The metabolic effect of the practices of *asana*, *pranayama* and meditation synergize with other physical effects and contribute to health, fitness and sense of well-being. Yoga is an essential variable in the prevention of CVS disease associated with diabetes. It results in improvement in cardio-respiratory performance and psychological profile within improved sense of well-being.

Asanas, when practiced along with *pranayama* and meditation over a period of time, significantly reduce the metabolic rate due to decreased sympathetic nervous system activity. The metabolic effect through practices of *asana, pranayama* and meditation may work in synergy with the physical effects, maintaining uniqueness of yoga from other forms of exercise in delaying the onset of cardiovascular, circulatory and autonomic dysfunctions in diabetes.

Yoga practice maintains muscle strength and bone density, joint flexibility and improves posture, balance and mobility. Yoga, combined with *pranayama* and meditation, maintains circulatory and respiratory health fitness.

Type-2 diabetes, heart disease, arteriosclerosis, atherosclerosis, liver disease, elevated cholesterol and hypertension are the medical conditions associated with insulin insensitivity and elevated blood glucose levels. It has been suggested that exercise, brisk walk, relaxation and stress reduction cause weight loss, healthier distribution of body fat and increase in insulin sensitivity.

With modernization and exacerbation of work stress, the importance of yoga cannot be ignored. It has evolved as a holistic approach to combat work-related stress, anxiety and depression. Psychological stress activates the oxidation process at membrane lipid level, disrupting the membrane, and causing release of oxygen at tissue level to relieve hypoxia. This tissue hypoxia plays important role in pathogenesis of cardiovascular disease, which is exacerbated in diabetes. High level of stress leads to increased cortisol level, which causes mobilization of fatty acids from fat stores, leading to higher level of abdominal fat. There is strong association between increased waist circumference (owing to the abdominal fat) and insulin insensitivity owing to increased fatty acids and diabetes.

Any form of exercise can reduce abdominal fat but the uniqueness of yoga to alleviate stress with cardio-protective effect is effective and incomparable. However, yoga and relaxation techniques may not cause overall weight loss, but result in healthier distribution of body fat in overweight subjects.

Limited literature is available on the effect of yoga practice on fasting blood glucose level, haemoglobin and glycosylated haemoglobin among diabetics. The present study was undertaken to comment on the beneficial

effect of long-term practice of yoga on glycemic profile in diabetics.

In the present study, the mean value of fasting blood glucose was less than that of controls and the difference between the two was statistically highly significant. Our observations were in compliance with the study conducted by Cerranque et al.[9], who conducted haematological and biochemical profile in 26 subjects. The experimental group consisted of 16 long-term yoga practitioners and 10 healthy ordinary subjects. The results revealed a decrease in the blood glucose level in yoga practitioners, as compared to controls.

Our findings are also in compliance with the study conducted by Hegde et al.[10] on the effect of three month yoga practice on oxidative stress in type-2 diabetics. Yoga practitioners achieved significant improvement in body mass index, fasting blood glucose level, post-prandial blood glucose, glycosylated haemoglobin, glutathione and vitamin-C at 3 months compared with the standard care group. Gordon et al.[11] also reported 20% reduction in oxidative stress and decrease in blood glucose level.

The present study demonstrated that yoga practice can cause a noticeable increase in haemoglobin, which explains the cardio-protective role of yoga by improving cell oxygenation through supplying red blood cells richer in haemoglobin, without increasing the percentage of red blood cells and blood viscosity which could be a cardiovascular risk factor.

Physical and mental stress, conditioned by sympathetic stimulation, raises blood pressure and elevates capillary hydrostatic pressure, facilitating the flow of plasma from the vascular compartment to the interstitial compartment – thus increasing blood viscosity in the capillaries, which is a cardiovascular risk. *Pranayama*, meditation and cognitive behaviour therapy alleviate stress and reduce cardiovascular risk in diabetics.

The higher levels of haemoglobin suggest a modulating effect of yoga with clinical applications and therapeutic interventions in conditions where deficit of haemoglobin is present. The study suggests long-term yoga practice in patients with diabetes that causes marked drop in levels of glycemia, glycated haemoglobin and a rise in haemoglobin.

The long-term yoga practice is effective in decreasing body weight and blood glucose level. With the awareness of positive effects of yoga on cardio-respiratory, physical, metabolic and mental health, many people are inclined towards the benefits of yoga. The benefits of yoga are availed more by the people with sedentary lifestyles, work stress, increased body weight and above all diabetes.

The present study was an attempt to explore that yoga has a beneficial effect on glucose tolerance and insulin sensitivity. Yoga cannot cure diabetics but can bring in the lifestyle changes necessary to keep diabetic symptoms in check. Yogic measures line and shape the body, improves posture and circulation, and contributes to the sense of well-being. It is beneficial adjuvant for diabetic patients, as it helps to reduce the frequency of hyperglycemia and need for oral hypoglycemic. Thus, yoga can be used as an effective adjuvant of therapy in improving glycemic parameters, and can be administered as an add-on therapy to standard lifestyle interventions.

Advanced level of yoga practice also includes paying special attention to nutrition. A nutritious and vegetarian diet that includes vegetables, cereals, fruits, legumes, dairy products and honey are considered the pivots of the holistic yogic lifestyle.

Conclusion

Yoga can be used as an alternate therapy to reduce the blood glucose and glycated haemoglobin with improvement in the haemoglobin along with the drug therapy.

References

1. Michalsen A, Grossman P, Acil A, Langhorst J, Lüdtke R, Esch T, et al. Rapid stress reduction and anxiolysis among distressed women as a consequence of a three-month intensive yoga program. Med Sci Monitor 2009;11:555-61.
2. Smith C, Hancock H, Blake-Mortimer J, Eckert K. A randomized comparative trial of yoga and relaxation to reduce stress and anxiety. Complement Ther Med 2007;15:77-83.
3. Streeter CC, Whitfield TH, Owen L, Rein T, Karri SK, Yakhkind A, et al. Effects of yoga versus walking on mood, anxiety and brain GABA levels. A randomized controlled MRS Study. J Altern Complement Med 2010;16):1145-52.
4. Astin JA. Mind body therapies for the management of pain. Clin J Pain 2004;20:27-32.
5. Elavsky S, McAuley F. Physical activity and mental health outcomes during menopause: a randomized controlled trial. Ann Behar Med 2007;33:132-42.
6. Yurtkuran M, Alp A, Yurtkuran M, Dilek K. A modified yoga based exercise program in hemodialysis patients: A randomized controlled study. Complement Ther Med 2007;15:164-71.
7. Barnes PM, Powell-Griner E, McFann K, Nahin RL. Complementary and alternative medicine use among adults: United States, 2002. Adv Data 2004;343:1-19.

8. Adler R, Cohen N, Felton D. Psychoneuroimmunology: interactions between nervous system and immune system. Lancet 1995;345:99-103.
9. Cerranque GA, Maldonado EF, Vera FM, Manzaneque JM, Blanca MJ, Soriano G, et al. Haematological and biochemical modulation in regular yoga practitioners. Biomed Res 2012;23:176-82.
10. Hegde SV, Adhikari P, Kotian S, Pinto VJ, D'Souza S, D'Souza V. Effect of 3-month yoga on oxidative stress in type-2 diabetes with or without complications. Diabetes Care 2011;37:2208-10.
11. Gordon LA, Morrison EY, McGrowder DA, Young R, Fraser YTP, Zamora EM et al. Effect of exercise therapy on lipid profile and oxidative stress indicators in patients with type-2 diabetes. BMC Complement Altern Med 2008;21. doi: 10.1186/1472-6882-8-21

Cite this article as: Sharma N, Gupta N. Effect of yoga on glycemic profile in diabetics. Int J Med Sci Public Health 2014;3:1135-1140.
Source of Support: Nil
Conflict of interest: None declared