Research article

Effect of lifestyle intervention in Type II diabetes

Uma Vijayashankar[1], Rajalakshmi R.[1], Ramya C.M.[1], Bhanu Kumar[2], Smitha M.C.[3]

[1]Department of Physiology, [2]Department of Medicine,[3]Department of Community Medicine, JSS Medical College, JSSAHER, Mysuru, Karnataka, India

(Received: September 2021 Revised: April 2022 Accepted: May 2022)

Corresponding author: **Uma Vijayahankar.** Email: umavijayashankar@gmail.com

ABSTRACT

Introduction and Aim: Sedentary habits, unhealthy dietary patterns and psychological stress are the major potential problems for the advancements of a various life style disorders like Diabetes mellitus. Yoga is a lifestyle intervention, an effort to keep the condition under control and ameliorate overall quality of life. The idea of this research study among Type II diabetics is to assess the effectiveness of metabolic control with life style intervention (yoga) for 6 months.

Materials and Methods: 200 subjects aged 30–60 years of either gender recently diagnosed with Type II diabetes were randomized into 4 groups and were given 6 months intervention which included supervised regular yoga practice, diet and educational sessions. Weight, BMI, glucose, HbA1c, Insulin and lipid profile were measured before commencement, and after 6 months of the intervention. The statistical methods't' test and ANOVA were applied to assess the "mean and difference" at p value 0.05.

Results: Alterations in the life style of Type II diabetics with the intervention of yoga, diet and educational sessions showed a significant profitable impact on weight, BMI, fasting glucose, insulin, HbA1c, and lipid profile.

Conclusion: Short term interventions produced positive modest changes in metabolic control. These lifestyle modifications with the intervention of yoga and diet counselling is effective in the management of weight loss, glycemic control, plasma Insulin and lipid profile levels which on longer duration may yield a better effective result along with constant motivation.

Keywords: Diabetes mellitus; metabolic control; yoga.

INTRODUCTION

Type II Diabetes mellitus (Type II DM) is the most common metabolic disorder, characterized by defects in insulin action and secretion leading to hyperglycaemia added metabolic dysregulation such as deranged lipid profile and weight gain (1). In addition to the genetic factors, non-genetic or life style risk factors like physical inactivity, poor nutrition, increased body mass index, hypertension, stress, smoking and alcohol use are some of the major modifiable risk factors of Type II Diabetes Mellitus (2). Individuals with Type II DM desire behaviour and life style alterations along with the conventional medicinal therapies to reduce the possible complications of diabetes and to improve the quality of life (3). Consistent findings from various studies shows that lower levels of physical activity increases the person's risk for diabetes and it is a prerequisite to develop few important effective behavioural interventions that target this important life stage (4). In our study we have opted Yoga as a life style behavioural intervention for diabetics, as it is cost effective, non-invasive and can also be adaptable by persons with severe limitations in physical activity like in obesity (5). Yoga was originated about 4000 years ago and the practice of yoga in the recent decades is steadily increasing in the western industrialized countries (6). Yoga is an activity that combines physical movement (ASANAS), breathing (PRANAYAMA), meditation (DYANA) and mindfulness (7). Regular participation in yoga increases the self-efficacy and motivation which increases physical activity and in turn improves physical and mental health symptoms. Constant motivation is critical to retain the regular practice and to keep up the health benefits following intervention (8,9). The major goals in the battle to treat diabetes is to alter the dietary patterns and to cut down the increase caloric consumption (10) , weight reduction, increase physical activity and to track the glycemic index (11,12). Yoga focuses on engagement in the physical activity, behaviour and diet rather than fitness or physical appearance (13). Several researchers observed the positive effectiveness of yoga along with dietary alterations as a part of lifestyle modification in the treatment of DM (14). Hence we hypothesize that yoga is beneficial in reducing the metabolic derangements in Type II DM. The objective of our work was to

evaluate the effects of yoga on weight, BMI, fasting blood glucose (FBG), plasma insulin, HbA1c, and lipid profile levels in Type II DM.

MATERIALS AND METHODS

A randomized 24 weeks (6 months) yoga intervention study was conducted on 200 subjects and carried out at Department of Physiology, JSS Medical College, Mysuru and at Patanjali yoga centres, Mysuru. The study protocol was approved by the ethical committee and informed consent was obtained by all the self-willing participants after they were briefed about the research before enrolling into the study. Questionnaire was given to all subjects and the detailed history of the subjects that includes age, gender, disease history along with duration and complications, treatment history about present intake of any medicines, dosage and duration of treatment were noted. Inclusion criteria for enrolment included sedentary type II diabetes between 30 and 60 year old of either sex, duration of the disease between 1 years and 10 years with HbA1c levels > 6% and < 9%, non-smokers and non-alcoholics. Exclusion criteria included overt albuminuria, congestive cardiac failure any severe illness like malignancy, kidney disease, respiratory disease, impairment in hearing, speech, pregnant women, hypertension, orthopaedic constraints any musculoskeletal injury impeding exercise and with known cerebrovascular, retinopathy, coronary artery and nephropathy diseases are excluded from the study. 200 Type II DM subjects were selected for the study from the OPD, Department of Medicine, JSS Hospital, Mysuru.

Anthropometric variables of height and weight were measured using standard protocol with light clothes and no foot ware. BMI was calculated and BP was recorded. Fasting blood samples of anti-cubital vein from participants were taken and assessed for HbA1c, fasting glucose, plasma insulin and lipid profile –HDL (High density lipoprotein), LDL (Low density lipoprotein), very low density lipoprotein (VLDL), Total cholesterol (TC) and Triglyceride (TG). All the variables were measured at baseline and at the end of 24 weeks (6 months) of intervention.

Intervention sessions for participants were randomly allocated to four groups consisting of 50 participants in each group. Group 1 underwent *yogasanas* alone, Group 2 practiced only diet modifications, Group 3 attended yoga sessions and followed diet modifications. Added all three groups attended educational sessions conducted every fortnight and Group 4 were controls.

Groups 1 and 3 attended 1 hour sessions that included asanas (body postures) and pranayama (breathing exercises). in overnight fasting state at 5:30 in the morning, 7 days a week on daily basis for 60 minutes which was supervised and conducted by trained yoga instructors at yoga centres, Mysuru.

All the groups except the control group attended 12 educational sessions every fortnight for 1 hour, designed to focus on, the importance of ongoing medical treatment, knowledge about overweight/ obesity, diabetes, physical activity, yoga and stress management conducted by nutritionist and health educators at yoga centres.

Group 2 and 3 also attended 12 diet and nutrition counselling sessions conducted by nutritionist every fortnight along with educational sessions.

Group 4 the control group were asked to report every 1st week of each month to the Department of Physiology or through phone for their follow up. There were no alterations made in the ongoing treatment of any of the groups.

SPSS version 24 was used for data entry and analysis. Descriptive statistics analysis of pre and post-test was done by using "t" test to analyse the difference in means in same group and one way ANOVA was applied for comparison between the groups. p-value of < 0.05 was considered as level of statistical significance.

RESULTS

Two hundred Type II diabetics participated in the study. Table 1 shows the mean age (in years) of participants in the group provided intervention with yoga alone was 43.7±6.7, group provided dietary intervention alone was 44.6±6.3 and group provided yoga, dietary and educational intervention together was 43.7±6.3 and control group was 46±7.4.

Table 1: Mean age of participants in the groups

Group	**Age** (in years)
Group 1	43.7 ± 6.7
Group 2	44.6 ± 6.3
Group 3	43.7 ± 6.3
Group 4	46.0 ± 7.4

Table 2 shows comparison of weight, BMI, blood glucose, insulin and HbA1c before and after intervention that revealed statistical significant difference in weight and fasting blood glucose ($p<0.01$) in all groups and there were no statistical significant difference observed between pre and post-test among group 2 in variables of BMI and HbA1c and also there was no statistical significant difference in group 1, 2 and 3 in insulin between pre and post-test.

Table 3 shows correlation of pre and post-test of lipid profile that revealed statistical significant difference in all the groups.

Table 4 shows on application of ANOVA for the comparison of various parameters between the intervention groups and control group revealed that all the parameters showed significant statistical difference between the groups except for weight and hence BMI and it also observed that on application of Post Hoc Bonferroni Test, LDL statistically significant difference was seen between the group 3 provided with combined yoga, dietary and educational intervention compared to the controls, with intervention showing reduction in LDL level. HDL, statistically significant difference was seen between the group 2 provided dietary intervention in comparison to control group, with the HDL level increasing in the intervention group. With VLDL, Total Cholesterol and Triglycerides all the three groups had statistically significant difference in comparison with the control group, with the levels of all the three reducing after intervention. Fasting blood glucose and insulin levels of group 1 provided intervention with yoga alone and group 3 provided intervention with combined yoga, dietary and educational sessions showed significant statistical difference in comparison with the control group, with both their levels decreasing with intervention. The insulin levels have increased from pre to post intervention in the groups 1 and 2 provided yoga intervention alone and dietary intervention alone. However, it is to be noted that the HBA1c levels reduced in all the intervention groups.

Table 2: Comparison of various parameters before and after intervention

Group	Variables														
	Weight			BMI			Fasting blood glucose			Plasma Insulin			HbA1c		
	A	B	P value	A	B	P value	A	B	P value	A	B	P value	A	B	P value
1	76.6 ±14.6	74±14.1	<0.001	31±6.3	29.9±6.1	<0.001	165.9±36.6	146.1±35.1	<0.001	18.2±7.5	18.9±7.6	0.112	7.5±0.6	7.3±0.5	0.001
2	77.8±16.9	76.7±16.5	<0.001	32±6.9	31.7±7	0.329	172.7±43.2	182.2±42.5	<0.001	15.9±7.2	16.5±7.8	0.231	7.90.9	7.80.9	0.284
3	80.4 ±15.4	73.2±14.9	<0.001	32.6±6.4	29.7±7	<0.001	174.8±61.1	132±42.5	<0.001	17.8±5.6	14.3±4.9	0.008	8.3±1.5	6.7±1	<0.001
4	69.6 ±17	70.9±17.0	<0.001	27.7±7	28±7.1	<0.001	160.641.5	187.153.9	<0.001	17.2±8	20.6±7.7	<0.001	6.6±1.1	7.5±1.4	<0.001

* A- Pre-test; B - Post-test

Table 3: Comparison of lipid profile parameters before and after intervention

Group	Variables														
	LDL			HDL			VLDL			Total cholesterol			Triglyceride		
	A	B	P value	A	B	P value	A	B	P value	A	B	P value	A	B	P value
1	153±24	136.7±23.5	<0.001	40.3±3.8	41.4±4	<0.001	22.6±4.7	17.6±5.4	<0.001	200.7±15.4	180.3±18.3	<0.001	157.8±29.1	144.5±26.9	<0.001
2	150±25.2	132.9±22.6	<0.001	43.4±5.6	44.9±5.6	<0.001	27±6.2	21.6±7	<0.001	213.8±172.9	185.4±18.6	<0.001	149.26±30.91	124.6±25.6	<0.001
3	159.6±26.4	131.4±25.5	<0.001	37.9±4.6	44.5±4.9	<0.001	27.6±6.9	20±7.9	<0.001	211.1±20.8	179.7±19.3	<0.001	69.1±38.3	114.5±17.5	<0.001
4	136.7±27.3	148.2±26.7	<0.001	42.5±3.1	40.5±2.8	<0.001	24.1±5.4	28.9±5.4	<0.001	208.6±22	220.2±13.4	<0.001	145.6±32.4	180.9±36.3	<0.001

*A- Pre test, B - Post test

Table 4: Comparison of various parameters between the intervention groups and control group

Variables	Mean ± Standard Deviation				F value	P value*
	A	B	C	D		
Weight	74±14.1	76.7±16.5	73.2±14.9	70.9±17	1.162	0.326
Body Mass Index	29.9±6.1	31.7±7.0	29.7±7	28.3±7.1	2.149	0.095
Low Density Lipoprotein	136.7±23.5	132.9±22.6	131.4±25.5	136.7±27.3	4.75	0.003
High Density Lipoprotein	41.4±4.0	44.9±5.60	42.5±4.8	40.5±2.8	8.92	<0.001
Very Low Density Lipoprotein	17.6±5.4	21.6±7.0	20±7.9	28.9±5.4	27.6	<0.001
Total Cholesterol	180.3±18.3	185.4±18.6	179.7±19.3	220.2±20.4	60.4	<0.001
Triglycerides	144.5±26.9	124.6±25.9	114.5±17.5	180.9±36.3	56.6	<0.001
HbA1c	7.0±0.5	7.8±0.9	6.7±1	7.5±1.4	10.69	<0.001
Fasting Blood Sugar	146.1±35.1	182.2±42.5	132±42.5	187.1±53.9	18.8	<0.001
Insulin	18.9±7.6	16.5±7.8	14.3±4.9	20.6±7.7	7.9	<0.001

*A- Group 1, B- Group 2, C- Group 3, D- Control group

DISCUSSION

This research work was designed to observe the effects of *yogasanas,* diet, combined effects of *yogasanas* and diet along with educational sessions on type II diabetes mellitus for a period of 6 months on blood glucose, insulin, HbA1c and lipid profile. It is observed that all the parameters except for weight and hence BMI showed significant statistical difference between the groups. On comparison between the groups fasting blood glucose and insulin showed statistical significant difference among group 1 and 3 and insulin levels have increased in pre to post intervention in groups 1 and 2. HbA1c levels have reduced in all the groups after intervention and statistical significant difference was noted in group 3 when compared to controls. In lipid profile, LDL showed significant statistical difference in group 3 and HDL showed statistical significant difference with increasing levels in group 2.VLDL, Total Cholesterol and Triglycerides showed significant statistical difference in all groups when compared to controls.

The yogic intervention resulted in overall decrease in values of fasting blood glucose, HbA1c, LDL,VLDL, TG, TC and an increase in HDL and Insulin levels.

With the practice of *yogasanas* alone Group 1 showed decrease in VLDL, TC, TG, FBG and Insulin levels when compared to controls, which are similar to previous studies. Similar findings were noted by Shantakumari*et al.*(15) Mondal *et al*. (16), Chimkode *et al*., (17) Sharma *et al*., (18).

The observations suggest that responsiveness of pancreatic B cell to glucose signal increases on practicing *asanas* on regular basis. A research observation by Malhotra *et al.*, showed that practice of *yogasanas* in individuals with type II diabetes with different postures had a positive effect on glucose utilization and fat redistribution. Various *yogasanas* directly rejuvenates the beta cells of pancreas and also sensitivity of the beta cells of pancreas increases by alternating contraction and relaxation postures involved in asanas. Studies also suggest that there is increase glucose uptake following intervention as there is enhanced insulin receptor expression in the muscles due to increase blood supply to muscles (19,20).

The prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL, low HDL along with type II diabetes are all risk factors for cardiovascular diseases (21). The studies also revealed that following yoga intervention there is increased uptake of TG by adipose tissue and hence there is improvement in the lipid profile levels. This response is possibly due to increased hepatic and pancreatic lipase that in turn increases the metabolism of lipoprotein (22).

Yoga is an art of healthy living. Regular practice of yoga brings perfect harmony between body and mind. Yoga, according to Maharshi Patanjali- is the process to gain mental clarity and inner peace through the process ashtanga sutras proposed, they are *yamas*(moral codes), *niyamas*(self-discipline), *asanas* (posture), *pranayama*(breath control), *pratyahara* (withdrawing the mind away from perceptible external stimuli), *dharana* (concentration), *dhyana* (meditation) and finally to attain the state of *samadhi* (ones with self) (23). Other than asanas and pranayama, diet is also an integral part of yoga as it reduces overeating and emphasis on mindful eating and better stress

management (7). In our study we incorporated dietary modifications in group 2 and along with *yogasanas* in group 3 and observed modest beneficial changes in group 3 provided combined *yogasanas*, diet and educational sessions. A pilot study by Miller *et al.*, showed that mindful eating facilitates improvement in dietary practices, weight loss and thereby glycaemic control (24).

Yoga is more widely accepted and is progressively promoted as an intervention to promote its health benefits globally. It is apparent in many life style diseases like diabetes that the individuals must change attitude and behaviour so as to successfully treat and overcome the disease. To achieve this, yoga intervention programs requires an active and adherent regular practice that might be a crucial point that limits the potential beneficial effects of yoga (25). To overcome this, in our study we included an educational program as a motivational sessions among group 3 for every fortnight to make the participants to understand the advantages and to maintain continuous perception for practicing yoga on daily regular basis to ameliorate the health problems which showed a beneficial effect on all the parameters in that group compared to other groups and also significant statistical difference was observed in all the parameters except for body weight and body mass index.

CONCLUSION

Our study confirms the beneficial role of yoga in the control of Type II DM. The discipline of yoga diminishes the fluctuations of the mind by acting consciously; it is an indisputable connection between the mental, physical and overall health and wellbeing. It is thus pertinent to consider the role of motivation to sustain the regular practice of yoga. The results also suggest further investigations to notice the profitable effects of yoga on long term regular practice and also to include the gender variations.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Ferrannini, E. Insulin resistance versus insulin deficiency in non-insulin dependent diabetes mellitus. Problems and prospects. Endocrinology Review. 1998;19:477-490.
2. Kaye, S.A., Folsom, A.R., Sprafka, J.M. Increased incidence of diabetes mellitus in relation to abdominal adiposity in older women. J Clin Epidemiol. 1991;44:329-334.
3. Aljasir, B., Bryson, M., Al-Shehri, B. Yoga practice for the management of type II diabetes mellitus in adults: A systematic review. eCAM 2010;7(4): 399-408.
4. Deshpande, A.D. Epidemiology of diabetes and diabetes-related complications. American Physical Therapy. 2008 Nov;88(11):1254-1264.
5. Sharma, M., Knowlden, A.P. Role of yoga in preventing and controlling type 2 diabetes mellitus. Journal of Evidence-Based Complementary and Alternative Medicine.2012 Feb;17(2):88-95.
6. Innes, K.E., Bourguignon, C., Taylor, A.B. Risk indices associated with the insulin resistance syndrome, cardiovascular disease, and possible protection with yoga: a systematic review. Journal of American Board of Family Medicine. Nov2005;18(6):491-519.
7. Watts, A.W., Rydell, S.A., Eisenberg, M.E., Laska, M.N., Neumark-Sztainer, D. Yoga's potential for promoting healthy eating and physical activity behaviours among young adults: A mixed-methods study. International Journal of Behavioral Nutrition and Physical Activity. 2018;15:42.
8. Martin, E.C., Dick, A.M., Scioli-Salter, E.R., Mitchell, K.S. Impact of a yoga intervention on physical activity, self-efficacy, and motivation in women with PTSD symptoms. Journal of Alternative and Complementary Medicine. 2015;21(6):327-332.
9. Lian, C.W. Commitment and motivation in practicing yoga among adults in Kuching, Sarawak. Indian Journal of Traditional Knowledge. June 2017;16:S81-S87.
10. Desai, B.P. Place of nutrition in Yoga. Ancient Science of Life. Jan1990;9(3):147-153.
11. Aswathy, S., Unnikrishnan, A.G., Kalra, S. Effective management of type II diabetes in India: Looking at low-cost adjunctive therapy. Indian Journal of Endocrinology and Metabolism. Jan-Feb2013; 17(1):149-152.
12. Manyam, B.V., Sahay, B.K., Sahay, R.K. Lifestyle modification in management of diabetes mellitus. Journal of Indian Medicine Association. 2002;100:178-180.
13. Prichard, I., Tiggrmann, M. Relations among exercise type, self-objectification, and body image in the fitness centre environment: The role of reasons for exercise. Psychology of Sport and Exercise. 2008; 9(6):855-866.
14. Suri, M., Sani, M. Exploring the effects of yoga and diet counselling on dietary intake of college going females. International Journal of Physical Education, Sports and Health. 2017;4(1):155-160.
15. Shantakumari, N., Sequira, S., Elderb, R. Effects of yoga intervention on lipid profiles of diabetic patients with dyslipidemia. Indian Heart Journal. March 2013;65(2):127-131.
16. Mondal, S., Kundu, B., Saha, S. Blood sugar and lipid profile, adaptations to yoga therapy. Journal of Yoga and Physical Therapy. 2014;4(4):175.
17. Chimkode, S.M., Kumaran, S.D., Kanhare, V.V., Shivanna, R. Effect of yoga on blood glucose levels in patients with Type II Diabetes Mellitus. Journal of Clinical and Diagnostic Research. April 2015;9(4):CC01-CC03.
18. Sharma, A., Sharma, M., Sharma, R., Meena, P.D., Gupta, M., Meena, M. Effect of yoga on blood glucose and glycosylated haemoglobin level in Diabetes Mellitus Type 2 patients. International Journal of Medical Science and Education. 2015;2(1):2349-3208.
19. Malhotra, V., Singh, S., Tandon, O.P., Sharma, S.B. The beneficial effects of yoga in diabetes. Nepal Medical College Journal. 20005;7:145-147.
20. Thangamani, S.R., Chandani, A.L., Thangasami, S. Emphasis of yoga in the management of diabetes. Journal of diabetes and metabolism. 2015;6:613.
21. Mahato, R.V., Gayawali, P., Singh, P.P.S.D., Regmi, P., Singh, K.P.S.D., Pandeya, D.R. Association between glycaemic control and serum lipid profile in type 2 diabetic patients: Glycated haemoglobin as a dual biomarker. Journal of Biomedical Research. 2011; 22(3):375-380.
22. Dash, S., Thakur, A.K. Effect of yoga in patients with type II diabetes mellitus. Journal of evolution of medical and dental sciences. 2014; 3(7):1642-1655.
23. Taneja, D.K. Yoga and health. Indian Journal of Community Medicine. 2014; 39(2):68-72.
24. Miller, C.K., Kristellar, J.L., Headings, A., Nagaraja, H., Miser, W.F. Comparative effectiveness of a mindful eating

intervention to a diabetes self-management intervention among adults with type 2 diabetes: A pilot study. Journal of Academics Nutrition and Diet. 2012; 112:1835-1842.

25. Bussing, A., Michalsen, A., Khalsa, S.B.S., Telles, S., Sherman, K.J. Effects of Yoga on mental and physical health: A short summary of reviews. Evidenced Based Complementary and Alternative Medicine. 2012; 2012:1-7.