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A Comparative Study on Effect of Yoga Among Prediabetics on Progression of Cardiovascular Risk Factors

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ABSTRACT

Introduction: Diabetes is a chronic illness that requires continuing medical and healthcare and self education and life style modifications. Moreover, the disease manifestations start in the early stages of diabetes and before it gets established as a full blown condition in the pre-stage called prediabetes. Lifestyle interventions such as engagement in muscle-strengthening and conditioning activities (resistance exercise, yoga, stretching, toning) is associated with a lower risk of prediabetes and type 2 diabetes, Yoga constitutes asanas, regulated breathing (pranayama), and awareness of yoga sutras (principles) that govern the mind and preventing progression of prediabetes to type 2 diabetes. This comparative study highlights importance of six month yoga intervention in two groups of prediabetic subjects ,one group which perform yoga asans at home by the help of cd and video recording and other group which perform yoga asans at yoga centers in presence of yoga instructors, and use its as a tool for primary prevention of diabetes.
Methodology: This was a comparative Interventional study conducted at RUHS college of Medical Sciences and Associated Hospital in Jaipur city. The design of study was Prospective Intervention Comparative Study. A total of 202 prediabetic subjects of age group 30 to 50 years were recruited from Jaipuria Hospital. These were divided into two groups Cd and video recording group (Group A, n=101) were divided in control 51 and study group 51 which perform yoga asans by the help of cd and video recording at their home and other(Group B , n=101) divided in control 51 and study group 51 engaged in yoga session at the yoga centers . Protocol of yoga asans were same in both groups.
Results: Yoga intervention resulted in a significant decline in blood glucose (p< .001) in cd and video recording group and yoga center group, Glycated hemoglobin (p <.01) in cd and video recording group, lipid profile Cholesterol (p<.01) in cd and video recording group and (p<.001) in yoga center group ,Triglyceride(p<.01) in cd and video recording group and (p<.001) in yoga center group but HDL (p value =.2) in cd and video recordin group and (p value =.86) in yoga center group but statistically non significant relative to the control group.
Conclusion: Six month yoga intervention to be helpful in control of blood glucose and lipid profile in cd and video recording and yoga center groups of prediabetes subjects.
Yoga can be used as effective therapy in improving glycemic parameters i.e blood glucose and glycated haemoglobin and lipid profile. Comparative result showed that yoga beneficial in both the group but it would be better in yoga centers in terms of guidance by yoga instructor, regularity at particular place and time, motivation from community.

Key words: Prediabetes, yoga, cardiovascular risk

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INTRODUCTION

Diabetes is a chronic illness that requires continuing medical and healthcare and self education and life style modifications.1

Moreover, the disease manifestations start in the early stages of diabetes and before it gets established as a full blown condition in the pre-stage called prediabetes.

According to the American Diabetes Association, the diagnostic criteria for prediabetes is an elevated fasting plasma glucose level (100 mg/dL–125 mg/ dL),a glycated hemoglobin (HbA1c) value of 5.7% to 6.4%, or an elevated plasma glucose level after an oral glucose tolerance test (140–199 mg/dL).2

Lifestyle interventions such as engagement in muscle-strengthening and conditioning activities (resistance exercise, yoga, stretching, toning) is associated with a lower risk of prediabetes and type 2 diabetes, Yoga constitutes asanas, regulated breathing (pranayama), and awareness of yoga sutras (principles) that govern the mind and preventing progression of prediabetes to type 2 diabetes.3

Lifestyle interventions such as yoga can prove to be a beneficial non pharmacologic intervention in preventing progression of prediabetes to type 2 diabetes.The science of yoga is an ancient one and benefits all components of health.

The word Yoga is derived from the Sanskrit word ‘Yuj’ meaning union of the body, breath and mind. Good health due to Yogic practices could be the effect of right thought and action. Yoga as a way of life is more true to its ancient tenets. It constitutes asanas, regulated breathing (pranayama), and awareness of yoga sutras (principles) that govern the mind.4 Regular practice of yoga enhances awareness of mind and body, which is needed in the self-management of diet and exercise plan in diabetes.

Landmark studies have shown an important role of lifestyle modification in the prevention of type 2 diabetes.5-7 Patients with diabetes may be unable or unwilling to participate in conventional types of physical activity (gymnasium based and vigorous strength training) due to limited joint mobility, capsulitis, and physical unfitness associated with overweight and sedentary lifestyle. In such a scenario, gentle yogic stretches performed under guidance with mind, body, and breath awareness might bring the body/mind back in condition fit again for more vigorous exercises required to have a direct effect on lowering plasma glucose. Limitations and barriers in enrollment and follow-up from the previous studies.8 tell us that these stretches and asanas need to be tailored according to the participant's need. .

Long duration practice of yoga has shown to have a beneficial effect on cardiovascular reactivity.9-10 A randomized controlled trial showed that in a 6-month period, practice of comprehensive yogic breathing had beneficial effects on cardiac autonomic functions in patients with diabetes who followed the comprehensive yogic breathing program compared to those who were on standard therapy alone.11-12 Since cardiac dysfunction has been implicated in sudden cardiac death in diabetes, this finding may translate to practice of yogic breathing program being useful in delaying sudden cardiac death.

In contrast to physical exercises such as walking, that improve blood flow by movement of skeletal muscles, Yoga postures restore internal balance and homeostasis of the body by influencing every organ system. In the human body, there are some glandular structures which have both an internal as well as an external secretion.13 The best examples are the pancreas. The pancreas secretes insulin. The Yogic

therapeutics helps in restoring the internal secretions to their normal value by securing the health of all the endocrine organs. For example - ardthmatsyendra asana influences the pancreas and restores insulin balance.14 However, there were no comparative studies available on Integrated approach of yoga therapy(IAYT) on cardiovascular & biochemical parameters in prediabetics. Hence, this study is designed to assess the effect of IAYT on biochemical parameters in prediabetics... Hence, this article elucidate the role of yoga and its association with biochemical parameters, in prediabetics.

The effect of yogic practices on the management of prediabetes has not been investigated well. The aim of this well designed six month interventional study was to assess the effect of Integrated Approach of Yoga therapy on glycaemic control and lipid profile,heart rate variability in prediabetics and comparison of yoga intervention between two groups i.e cd and videorecording group and yoga center group.

Material and Method

A prospective comparative, single blind study was conducted among prediabetic adults aged 30 to 50 years in tertiary health care center, Jaipur, Rajasthan, India. Written informed consent was taken from the participants in the local language and the study was approved by ethics committee of the RUHS College of Medical Sciences. A total of 2850 participants were screened out of which 245 were found to be prediabetic. Prevaleance rate was 9.8%. Survey was conducted from 2017 July to December 2018 .Prediabetic subject also screened from different yoga centers two yoga centers of malviya nagar and one yoga center of pratap nagar details of different yoga center given below

Table 1: Recruitment of Subjects from different yoga centers

S.NO	Yoga center	Total Number of subjects
1.	Malviya Nagar yog sadhana center- 1	17
2.	Malviya Nagar yog sadhana center -2	16
3.	Patanjali yoga center-Pratap Nagar	18
	Total Number of subjects	51

Details about the age, sex, family history, sociodemographic, lifestyle, physical activity, Body mass index, dietary habits medical factors were recorded in the information collection proforma.

Pre-diabetes Questionnaire

1.	Name					
2.	Age					
3.	Sex					
4.	Height					
5.	Weight					
6.	Body Mass Index					
7.	Occupation					
8.	Phone Number					
9.	Email					
10.	Have you had previous prediabetes education?	Yes	No			
	If yes, where?					
11.	How would you rate your unders tanding of pre-diabetes?	Very Good	Good	Fair	Poor	
12.	Do you have any food or drug allergies?	Yes	No			
	If yes, please explain:					
13.	Do you smoke?	Yes	No			
	If yes, how much?					
14.	Do you drink alcohol?	Daily	Weekly	Monthly	Rarely	Never
15.	What do you drink and how ma ny drinks do you have?					
16.	Do you currently have, or have you ever had?	Chest pain	High blood pressure	Neuropathy	Kidney disease	

17.	How often do you see your pre-diabetes physician? Date of last visit:				
18.	Do you perform a daily foot exa m?				
	If yes, when and why?				
19.	How often do you have a dental checkup?				
20.	Have you ever had an ECG or ca rdiac stress test?				
	If yes, what were the results?				
21.	Has your weight changed over the past year?				
	If yes, please describe:				
22.	Have you ever been on an extre me diet or fad diet?				
	If yes, please describe:				
23.	**Diabetes History** When were you diagnosed with pre-diabetes?				
24.	List blood relatives with diabetes .				
	Diabetes Questions & Knowle dge:				
25.	Have you received diabetes education before?				
	If yes, when & where				
26.	How would you rate your unders tanding of diabetes:	Very good	Good	Fair	Poor

27.	What is your biggest concern related to diabetes?				
28.	Are there any religious or cultural concerns you have relating to your diabetes?				
	If yes, what				
	Blood Sugar Monitoring:				
29.	Do you test your blood sugar?				
	If yes, when and how often?				
30.	Do you record your blood sugars ?				
	Physical Activity				
31.	What best describes your daily physical activity	Mild	Moderate	Severe	
32.	Do you follow a regular exercise program or not ?				
	If yes, what type of exercise do you do?				
33.	How many days per week do you exercise?				
34.	What time of day do you usually exercise?				
	Stress Management and Support				
35.	How does stress affect you physically or emotionally?	Sleeping difficulties	Depression	Eating too much/too little	Headaches

36.	Is there stress in your life				
37.	If yes, what is the source of stress?				
38.	How do you deal with stress?				
39.	Are family or significant others supportive of your pre-diabetes considerations?				
	Nutrition				
40.	What nutrition information would you like to learn more about?	Weight management	Nutrition strategies to control blood sugar		
41.	Do you have any specific nutrition questions you would like answered?				
42.	How often does your eating habits leave you feeling deprived?	Always	Often	Sometimes	Never
	Please explain				
43.	How many times a week do you eat away from home?				
44.	What types of restaurants do you usually eat or carry out				
45.	Do you ever skip meals?				
46.	How many meals do you usually eat per day?				
47.	How many snacks to you usually eat per day?				
48.	Do you get up during the night to eat or drink (other than water)?				
	If yes, what?				

49.	Do you eat for reasons other tha n hunger?			
	If yes, please describe:			
50.	Do you have trigger foods that o ften cause you to overeat?			
	If yes, what foods?			
51.	How often to you use nutrition st rategies to control your blood sugar or for other health reasons ?			
52.	Please write samples of your usual food and beverage intake and the times you eat your meals or snacks			
BREAKFAST		LUNCH	DINNER	SNACKS
53.	Medication List			
54.	Signature			

In this present study Stress was measured by cohen perceived stress scale. The Cohen Perceived Stress Scale (PSS) is the most commonly used psychological instrument for measuring the degree of stress. It is a measure of the degree to which situations in life are appraised as stressful. PSS showed adequate reliability and predictivity correlated with life event scores, depression, anxiety. The scale includes psychometric properties of the 10-item i.e., a number of direct questionnaire about current levels of experienced stress. The items are easy-to-use questionnaire with established acceptable psychometric properties. Moreover, the questions are of a general nature about thought and feeling in past month and not specific to any subpopulation.[15]

Table 1: Possible Risk Factors for prediabetes

S.No	Variable	PREDIABETES
1.	Age= 30 to 50 years	250
2.	Female gender	150
3.	Family history of diabetes	125
4.	BMI>25	170
5.	Central obesity	175
6.	Physical inactivity	200
7.	Psychosocial stress	200
8.	Vegetables< 2 servings a day	200
9.	Red meat, chicken, fish and egg> once time a week	40
10.	Fruit < one time in a week	152
11.	Green leafy vegetable < 3 times a day	178
12.	Bakery Items > once time a week	60
13.	Deep Fried Snacks	72
14.	Carbonated drinks>once a week	22
15.	Sweet> 3 time a week	80
16.	Tobacco use	40
17.	Alcohol use	60

Table 1 shows risk factors in prediabetes.

Prediabetes was defined as per American Diabetes Association criteria.[5]According to the American Diabetes Association, the diagnostic criteria for prediabetes is an elevated fasting plasma glucose level (100 mg/dL–125 mg/ dL), a glycated hemoglobin (HbA1c) value of 5.7% to 6.4%, or an elevated plasma glucose level after an oral glucose tolerance test (140–199 mg/dL).[5] Other inclusion criteria were no history of cardiovascular disease in subject or in first-degree relatives, history of diabetes was taken by all the prediabetics subjects, and should not be on drugs which affect blood sugar levels. A total of 202 prediabetics were recruited in the study groups one These were randomly divided into two groups viz. study group (group A: n=101) i.e prediabetic with yoga intervention by help of cd and video recording group and second group (group B: n=101) ie prediabetic yoga intervention at yoga centers . Control group not performed any yoga intervention during study period..Base line parameters like anthropometic, blood pressure, pulse were recorded and biochemical parameters like blood glucose and lipid profile were measured using enzymatic colorimetric kits on a biochemistry analyser.The FPG was estimated by glucose oxidase-peroxidase,GOD –POD,end point method[13] HbA1Cwas measured by Immunoturbidimetric method .Serum lipid profile-Total cholesterol by enzymatic CHOD-PAP[16] and Triglyceride by enzymatic GPO-PAP[17] ,HDL –Cholesterol by phosphotungstic acidEnd point method[18] , LDL and VLDL calculated from the Friedewald's formula[19]Evaluation was done before yoga intervention then after six months post intervention and person carried out biomedical assessment were naïve to the group identity.

Yoga was used as an interventional therapy in this study. Yoga training was given by certified yoga instructor. These sessions were approximately 45 minutes six days in a week over a period of three month. The Integrated

Approach of Yoga Therapy included Prayer, Omkar recitation, yoga postures (asanas), breathing (pranayama) techniques,Shavasana ,Counseling and diet was also be part of the programme. To facilitate and guide home practice, participants were given an video recording (CD) of the yoga sessions recorded under direction of the certified yoga instructor in RUHS College of Medical Sciences and compliance of patients were checked by message daily and weekly telephonic conversions. The components of intervention using Integrated approach of yoga therapy are detailed in table 2.

Table 2: Schedule of yoga practices

S.N	Yogic Practices	Durati
1	Prayer	3
2	Omkar recitation	3
3	Pranayama	5
4	• Asans(SuryaNamaskar,Sukhasana,Bhujangasana,Pashimottanasana, Padmasana,Tadasana,Trikonasana,Sarvangasana,Ardhmatsyendrasana,Pawanmuktasana,Vajrasana,Dhanurasana)	30
	• Shavasana	5 Minutes

Table 2 shows yoga protocol in this study

The subjects were encouraged to perform all exercises as accurately as possible. Each asana lasted 30-60 seconds and some of them were repeated multiple times during a session. Subjects relaxed at the end of each yoga session, with 5 minutes of shavasana.

Statistical Analysis: Mean and standard deviations are calculated for each parameter. The appropriate tool for comparison the change in the level of a variable was student's paired t test for Intragroup comparison before applying this test the Smirnov-Kolmogorov test was conducted to confirm the normality of each parameter. For all the variables normality is confirmed. The level of significance is taken at 5%. There are 101 persons in both group. To show that initially the two groups are on the same platform for each parameter, student's unpaired t test is conducted for Intergroup comparison. If the value of p is more than 5%, for any parameter, that shows there is no significant difference between the two groups

RESULTS

All the parameters of the data are quantitative variables. The main purpose of the study is to compare the levels of these parameters before initiating Integrated approach of yoga therapy and after six month of practicing IAYT. Apart from comparing the various parameters of the data with respect to before and after Yoga, in both group i.e cd and video recording and yoga center groups comparison is made with respect to a control group. There are 51 prediabetics subjects in both the groups.

Table 3: Base line parameters in Control and Yoga groups

S.No	Base line parameters	Control at cd and video recording group	Control At yoga center	Yoga Cd and video recording group	Yoga at yoga center	p value
1.	BMI	28.6 ±3	28.7±2	27.8±7	26.8 ± 4	<.001
2.	Waist hip Ratio	90 ±6	92 ±6	91 ±7	85 ±4	<.05
3.	Blood pressure SBP	152± 8.3	153± 8.4	154± 7.3	130.7± 10.1	<.002
4.	DBP	90.8 ±4.2	90.7 ±4.3	92.8 ±4.2	88.3± 3.9	<.001
5.	Pulse Rate	90.2± 9.8	90.1± 8.8	89.2± 9.7	82 ±8 6	<.05

Table 3 showed that base line parameters like body mass index, waist hip ratio, blood pressure both systolic and diastolic bp, pulse rate both are decreased in cd and video recording and yoga center groups and results were statistically significant.

Table 4: Intragroup comparison of Results of Blood Glucose in CD group and Yoga center group

Groups	Pre		POST			
Cd and video recording group	MEAN	S.D.	MEAN	S.D.	p VALUE	INFERENCE
CONTROL	116.67	4.37	117.8	4.87	.844	NS
STUDY GROUP	116.87	4.57	108.75	5.51	<0.0001	HS
Yoga centers group						
CONTROL	116.08	4.71	116.08	4.71	1	NS
STUDY GROUP	116.12	4.08	104.63	3.35	<0.0001	HS

Table 4 shows intra group comparison of blood glucose in cd and video recording group and yoga center group and results of was statistically highly significant in both groups.

Table 5: Intragroup comparison of Results of Glycated Hemoglobin

	Pre		Post			
Cd group	MEAN	S.D.	MEAN	S.D.	p VALUE	INFERENCE
Control	6.41	.86	6.47	.90	.325	NS
Study	6.42	.11	5.67	.12	<0.01	S
Yoga centers group						
CONTROL	6.18	.216	6.18	.216	1	NS
STUDY GROUP	6.20	.20	5.90	.13	<0.01	S

Table 5 shows intra group comparison of Glycated haemoglobin in cd and video recording group and yoga center group and results of was statistically significant in both groups.

Table 6: Intragroup comparison of Results of Triglyceride (TG)

	Pre		Post			
CD Group	**MEAN**	**S.D.**	**MEAN**	**S.D.**	**p VALUE**	**INFERENCE**
TG Control	**132.35**	**7.39**	**133.36**	**8.20**	**.875**	**NS**
TG study	**133.36**	**7.52**	**128.78**	**8.10**	**<0.01**	**S**
Yoga group						
TG Control	**132.35**	**7.33**	**132.35**	**7.33**	**1**	**NS**
TG Study	**132.55**	**7.33**	**126.49**	**8.11**	**<.001**	**HS**

Table 6 shows intra group comparison of Triglyceride in cd and video recording group and yoga center group and results of was statistically significant in cd and videorecording group and highly significant in yoga center groups.

Table 7: Intragroup comparison of Results of Cholesterol

	Pre		**Post**			
CD Group	**MEAN**	**S.D.**	**MEAN**	**S.D.**	**p VALUE**	**INFERENCE**
Cholesterol Control	**187.92**	**5.48**	**188.94**	**5.98**	**.896**	**NS**
Cholesterol Study	**186.92**	**5.24**	**182.89**	**6.60**	**<0.01**	**S**
Yoga group						
Cholesterol Control	**187.92**	**5.32**	**187.92**	**5.32**	**1**	**NS**
Cholesterol Study	**186.86**	**4.84**	**180.22**	**6.94**	**<.001**	**HS**

Table 7 shows intra group comparison of Cholesterol in cd and video recording group and yoga center group and results of was statistically significant in cd and videorecording group and highly significant in yoga center groups.

Table 8: Intragroup Comparison of Results of HDL

	Pre		Post			
CD Group	**MEAN**	**S.D.**	**MEAN**	**S.D.**	**p VALUE**	**INFERENCE**
HDL CONTROL	**44.86**	**3.22**	**43.28**	**2.45**	**.1359**	**NS**
HDL STUDY	**44.88**	**6.52**	**46.28**	**2.35**	**.02**	**NS**
Yoga group						
HDL CONTROL	**44.88**	**2.05**	**44.88**	**2.05**	**1**	**NS**
HDL STUDY	**45.98**	**6.53**	**46.11**	**2.56**	**.86**	**NS**

Table 8 shows intra group comparison of HDL in cd and video recording group and yoga center group and results of was statistically non significant in both groups.

Table 9: Intragroup comparison of Results of Heart Rate variability

	Pre		Post			
	MEAN	**S.D.**	**MEAN**	**S.D.**	**p VALUE**	**INFERENCE**
Control	**2.18**	**1.09**	**2.20**	**1.05**	**.8862**	**NS**
Study	**2.19**	**1.09**	**1.01**	**0.54**	**<0.001**	**HS**
Control	**2.18**	**1.07**	**2.18**	**1.07**	**1**	**NS**
Study	**2.20**	**1.14**	**.99**	**0.53**	**<0.001**	**HS**

Table 9 shows intra group comparison of Heart rate variability in cd and video recording group and yoga center group and results of was statistically highly significant in both groups.

Table 10: Comparison Between Video and Cd Recording and in Yoga centers (Study Pre)

	IN VIDEO AND RECORDING		IN YOGA CENTRES			
	MEAN	S.D.	MEAN	S.D.	p VALUE	INFERENCE
Blood glucose	116.87	4.57	116.12	4.08	0.3022	NS
Glycated hemoglobin	6.42	0.11	6.2	0.20	<0.0001	HS
TG	133.36	7.52	132.55	7.33	0.4379	NS

Cholestrol	186.92	5.24	186.86	4.84	0.9530	NS
HDL	44.88	6.52	45.98	6.53	0.0010	VS
LF/HF	2.19	1.09	2.20	1.14	0.9547	NS

Table 11 shows comparison of blood glucose,glycated haemoglobin ,lipid profile i.e TG, cholesterol, HDL, Heart rate variability in study pre cd and video recording group and yoga center group and results was statistically non significant in blood glucose,TG,cholesterol,heart rate variabilityand highly significant in cholesterol and very significant in HDL both groups.

Table: 12 Comparison Between Video and Cd Recording and in Yoga Center (Study post)

	IN VIDEO AND RECORDING		**IN YOGA CENTRES**			
	MEAN	**S.D.**	**MEAN**	**S.D.**	**p VALUE**	**INFERENCE**
Blood glucose	**108.75**	**5.51**	**104.63**	**3.35**	**<0.0001**	**HS**
Glycated hemoglobin	**5.67**	**0.12**	**5.90**	**0.13**	**0.0902**	**NS**
TG	**128.78**	**8.10**	**126.49**	**8.11**	**0.1723**	**NS**
Cholestrol	**182.89**	**6.60**	**180.22**	**6.94**	**0.0001**	**HS**
HDL	**44.88**	**2.35**	**46.11**	**2.56**	**.7276**	**NS**
LF/HF	**1.01**	**0.54**	**0.99**	**0.53**	**0.8372**	**NS**

Table 12 shows comparison of blood glucose,glycated haemoglobin ,lipid profile i.e TG, cholesterol, HDL, Heart rate variability in study post in cd and video recording group and yoga center group and results was statistically non significant in Glycated hemoglobin,TG, HDL ,heart rate variability and highly significant in blood glucose and cholesterol in both groups.

Discussion

The effect of yogic practices on the management of prediabetes has not been investigated well. The aim of this study was to assess the effect of Integrated Approach of Yoga therapy on biochemical parameters in total duration of six months. Yoga intervention resulted in a significant decline in blood glucose ,Glycated hemoglobin , lipid profile Cholesterol ,Triglyceride ,LDL but HDL nonsignificant relative to the control groups. Yoga intervention low-cost, easily accessible lifestyle management program which holds promise as an approach to reducing cardiometabolic risk factors and increasing exercise self-efficacy for prediabetics performing yoga.[20]

The Diabetes Prevention Program Research Group has published several studies [18-20] showing that Type 2 diabetes may be modified by diet and life style modification. This finding suggests there is a scope of introducing intervention programmes in prediabetes to prevent progression of diabetes and related

complications like retinopathy, nephropathy, neuropathy and microangiopathy. Lifestyle modification is the most effective, low cost, cheaper and safer approach. Cohort studies , involved in the Finnish DPS and the 20 year follow up which was accomplished in the Da Qing Study, established that the beneficial effects of lifestyle intervention .[21,22]

The primary aim of lifestyle interventions is to prevent diabetes and its complications by targeting risk factor association with diabetes. Therefore yoga was introduced as intervention in the study. The results of the present study shows significant decrease in the blood glucose ($p \leq 0.001$) levels in the study group as compared to control group. In terms of blood glucose levels, results of present study are consistent with previous studies.[23-25,] These results can be attributed to that muscle contraction and dilation in asana and pranayama exercises stimulate the pancreas gland, so that the relaxation, deep breathing, muscle stretching ,bending and twists and turns of the spine where the pancreas is located, directly stimulate pancreatic cells, thus performing the asana increases insulin secretion and regulation.[26] Moreover, skeletal muscles have great ability in glucose uptake during exercise which is independent of insulin. Impact of exercise is to stimulate and reshape the GLUT-4 carrier of cell membrane from intracellular storage location. Mechanisms of yoga,bending and stretching are different messaging that rooted in an increase in calcium concentration caused by activation of the muscle fibers of the related motor neurons.[27]

A significant decrease in the Glycated hemoglobin ($P \leq 0.01$) has been observed in the present study in study as compared to the control group. Which was similar with the earlier study reported by Malhotra et al.[27] A significant improvement in glycosylated hemoglobin level, Fasting glucose level, and serum lipid profile in Yoga group compared to Educational group has been reported by vaishali et al [28]which was similar with present study

The decrease in lipid profile observed in this present study is in agreement with the previous studies[29-30] .The improvement in the lipid profile after yoga reason behind this could be due to increased hepatic lipase and lipoprotein lipase at cellular level, which affects the metabolism of lipoprotein and thus increase uptake of triglycerides by adipose tissues.[31-32]A 8-week, randomized controlled trial conducted by McDermott et al reported that yoga group had significant improvements in weight and waist circumference, cholesterol and blood pressure improved glucose control on the OGTT and decreased insulin resistance.[33]

A study conducted by Manjunatha et al [34] described the effect of four sets of asanas in random order for 5 consecutive days and observed that the performance of asanas led to increased sensitivity of B cells of the pancreas to the glucose signal. The mechanism of the anti-glycemic activity of yoga exercise has yet to be described. A mechanism of neurohormonal modulation involving insulin and glucagon activity remains a possibility.

In present study among prediabetics with elevated fasting blood glucose, participation in an 24 week yoga intervention was feasible and resulted in greater weight loss and reduction in waist circumference,body mass index ,Glycemic and lipid profile when compared to a control. Yoga offers a promising lifestyle intervention for decreasing type 2 diabetes risk factors and potentially increasing psychological well-being. The feedback of most of the participants enrolled in present study and performing yoga asans reported a feeling of wellbeing, more relaxed,calm,happy and satisfied, and a sense of relief from anxiety and stress. They were more alert and active which could be due to release of opiods and altered neuroendocrine adrenocortical

activity. Yoga-asanas with its change in posture and controlled breathing in pranayama influences mental status of an individual allaying apprehension, stress and brings about feelings of well-being, and neuroendocrine balance.[35]

Limitation : The findings of this study need to be explored in larger sample size involving prediabetics. . Larger clinical trials of lifestyle interventions that assess Glycemic and lipid profile as an endpoint are needed to provide convincing evidence in this regard.

Conclusion

The study clearly indicates that yoga is a potential intervention strategically in both groups one group which perform yoga asans at their home by help of cd and video recording and yoga centers, targeting prediabetics and should be the cornerstone for diabetes prevention. Results shows that yoga asans at the yoga center are more beneficial in terms of **Guidance, motivation and support, correction of yoga postures from a yoga instructor ,Community,____Inspiration, regularity at particular times .**It is a low-cost, easily accessible lifestyle management program which holds promise as an approach to reducing cardiometabolic risk factors and increasing exercise self-efficacy for prediabetics performing yoga.

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