Effect of Specific Exercise Programmes on Fasting Blood Sugar and Glycosylated Haemoglobin among Type 2 Diabetic Patients

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Abstract

The purpose of the study was to find out the effect of specific exercise programmes on fasting blood sugar and glycosylated hemoglobin among type 2 diabetic patients.To achieve the purpose of the study, 30 men diabetic patients aged between 40 to 50 years of Netaji Nature Cure Centre, Kakkanad, Kochi were selected as subjects. Fasting blood glucose levels (FBS) and Glycosylated Hemoglobin (HbA1c) were selected as variables for the study. The selected subjects were randomly assigned into two experimental groups of 15 members each. Experimental Group I (NCG) underwent Nature Cure programmes of the Netaji Nature Cure Centre and Experimental Group II (NCPSG) underwent the Nature Cure programmes Plus the Specific Exercise programmes given by the investigator. One Control Group (CG)of 15 diabetic patients who did not undergo any exercise programmes from the nearby locality was identified and fixed. The selected controls were in the early stages of diabetics. The training frequency was six days a week. The training period of the study was for twelve weeks. The subjects were tested on the selected variables prior to the commencement of the training programmes [pre test] and immediately after the sessions of the programmes [post test]. T test , Anova, Anacova and Scheffe's post hoc test was used to anlyse and interpret the data. No significant change was observed in NCG and NCPSG in HbA1c after training. Training significantly lowered the fasting blood glucose level of NCG and NCPSG as compared to CG

Introduction

Diabetes Mellitus is a condition where the body has trouble taking glucose from the blood and delivering it to the rest of the body so that it can be used as energy. This is because of lack of or an inability to use insulin, the hormone required for escorting glucose from the blood cells of the body. These people are insulin resistant meaning that they produce insulin, but it is not effective in escorting the glucose into the cells. Type 2 diabetes is now a common and serious global health problem, which, for most countries, has evolved in association with rapid cultural and social changes, ageing populations, increasing urbanization, dietary changes, reduced physical activity and other unhealthy lifestyle and behavioral patterns. During physical activity, whole-body oxygen consumption may increase by as much as 20-fold and even greater increases may occur in the working muscles. A decrease in plasma insulin and the presence of glucagon appear to be necessary for the early increase in hepatic glucose production during physical activity, and during prolonged exercise, increases in plasma glucagon and catecholamines appear to play a key role. The purpose of this position statement is to update and crystallize

current thinking on the role of physical activity in patients with Type 1 and Type 2 diabetes. (www.Cure.diabetesjournals.org)

Resistance training has recently been recognized as a useful therapeutic tool for the treatment of a number of chronic diseases and has been demonstrated to be safe and efficacious for the elderly and obese individuals. Similar to aerobic exercise, resistance training has been reported to enhance insulin sensitivity, daily energy expenditure, and quality of life. Furthermore, resistance training has the potential for increasing muscle strength, lean muscle mass, and bone mineral density, which could enhance functional status and glycemic control and assist in the prevention of sarcopenia and osteoporosis (Neil D Eves et al 2006).

Aerobic exercise for diabetic patients may include brisk walking, dancing, and swimming and other low impact exercise such as stationary walking or slow jogging. The intentions for this type of exercise is to increase the heart rate, work on muscles and improve the breathing capacity of the lungs. Aerobic exercises for diabetics are usually performed 30 minutes to an hour for 5 days a week. Aerobic exercise increases insulin sensitivity and along with proper nutrition, helps restore normal glucose metabolism by decreasing body fat.

The role of exercise in the treatment of lifestyle diseases especially in the treatment of Type 2 Diabetes has been established. However there is not much conclusive evidence of Nature Cures programmes being beneficial in the treatment of Type2 Diabetes. In this context, the effectiveness of Nature Cure programmes on Type 2 Diabetes and the combined effect of a specific exercise programmes along with the Nature Cure programmes was formulated and explored.The study was conducted at Nature Cure programmes of Netaji Nature Cure Centre, Kakkanad, Kerala.

Methods

To achieve the purpose of the study, 30 men diabetic patients aged between 40 to 50 years of Netaji Nature Cure Centre, Kakkanad, Kochi were selected as subjects. Fasting blood glucose levels (FBS) and Glycosylated Hemoglobin (HbA1c) were selected as variables for the study. The center regularly conducts Nature Cure programmes for all of its members including type 2 diabetic patients. The selected subjects were randomly assigned into two experimental groups of 15 members each. Experimental Group I underwent Nature Cure programmes of the Netaji Nature Cure Centre and Experimental Group II underwent the Nature Cure programmes Plus the Specific Exercise programmes given by the investigator. One Control Group of 15 diabetic patients who did not undergo any exercise programmes from the nearby locality was identified and fixed. The selected controls were in the early stages of diabetics. The training frequency was six days a week. The training period of the study was for twelve weeks. The subjects were tested on the selected variables prior to the commencement of the training programmes [pre test] and immediately after the sessions of the programmes [post test]

I. Nature Cure Programmes

The subjects for this study regularly underwent Specific Nature Cure programmes at Netaji Nature Cure Centre, Kakkanad.

Table 1

The daily schedule of the Nature Cure programmes

Time	Food	Exercise
7.15 am	Ash gourd/wheat grass Juice	Yoga- Suryanamskar, Yogasana, Standing, sitting and lying asanas, Pranayama and relaxation asanas
7.30 to 8.30 am		
8.30 am	Lemon Honey Juice/ Ginger Lime	
9.00-9.30 am		Sun bath
9.45-11.00 am	Tea/ Light Fruit Juice	Hydro Therapy treatments, like cold hip bath, body massage (Ayurveda, Swedish), Immersion bath, Under water massage, Gastro hepatic pack, Mud bath, Mud pack, Steam bath
11.15 am	Diet therapy- Boiled food diet, steamed vegetables, raw salad, fruits, tender coconut water, chapatti, aviyal, wheat dosa, chutney, wheat gruel	
11.30 am		
12.30 am	Lemon juice with honey, honey water, light fruit juice	
2.00 pm	Ash gourd juice	

3.00 to 4.00 pm		Mud therapy
4.30 pm		Reflexology track walking
5.00 pm		Honey mud rejuvenation facial
6.00 to 7.00 pm		Yoga
8.00 pm	Honey water	

II. Specific Exercise Programme (Weekly schedule)

Day	Type of Training	Intensity	Type of Exercise
Monday	Aerobic exercise	40% of MHR	Walking, Jogging, Slow running
Tuesday	Resistance Training	35% of 1 RM	Leg extension, wall sit, Shoulder press, Standing calf raise, Bench press, Good morning exercise
Wednesday	Aerobic exercise	40% of MHR	Walking, Jogging, Slow running
Thursday	Resistance Training	35% of 1 RM	Leg extension, wall sit, Shoulder press, Standing calf raise, Bench press, Good morning exercise
Friday	Aerobic exercise	40% of MHR	Walking, Jogging, Slow running
Saturday	Resistance Training	35% of 1 RM	Leg extension, wall sit, Shoulder press, Standing calf raise, Bench press, Good morning exercise

The data collected from Control Group, Nature Cure Plus Specific Group and Nature Cure Group prior to and immediately after training programmes on the selected variables were statistically analyzed by dependent 't' test, ANOVA and ANCOVA. Whenever the 'F' ratio for the adjusted post test

means was found to be significant, Scheffe's post hoc test was applied to determine which of the paired means was significant. The level of confidence was fixed at .05 levels in all the procedures.

Results

Glycosylated Hemoglobin (HbA1c)

The results of the dependent 't' test on the pre test and post test data obtained for Glycosylated Hemoglobin of the Control Group, Nature Cure Plus Specific Group and Nature Cure Group are presented in Table 3

Table 3

Dependent T Test for Pre and Post Test on Hba1c of Control Group,

Nature Cure Plus Specific Group and Nature Cure Group

Test	HbA1c	CG	NCPSG	NCG
Pre test	Mean	7.02	7.33	6.97
	SD	0.16	0.40	0.28
Post test	Mean	6.98	7.12	6.91
	SD	0.16	0.32	0.29
t test		1.57	2.60*	4.91*

*Significant at 0.05 level

Table 3 shows that the pre test mean and standard deviation of HbA1c value of Control Group, Nature Cure Plus Specific Group and Nature Cure Group are 7.02, 7.33 and 6.97 respectively. The post test mean and standard deviation are 6.98, 7.12 and6.91 respectively. The obtained't' ratio value between the pre test and post test mean on HbA1c of Control Group, Nature Cure Plus Specific Group and Nature Cure Group are 1.57, 2.60 and 4.91 respectively. The table value required for significant difference for df 14 at 0.05 level is 2.14. It was concluded that Nature Cure Plus Specific Group and Nature Cure Group have registered significant reduction in HbA1c levels.

The data collected prior to and post experimental period on Glycosylated Hemoglobin (HbA1c) of Control Group, Nature Cure Plus Specific Group and Nature Cure Group were statistically analyzed by analysis of variance to assess whether any significant difference existed among the Groups; before and after training and analysis of covariance to find out the effect of training and is presented in Table 4

Table 4

Analysis of Variance and Co-Variance on Glycosylated Hemoglobin (HbA1c) of Control Group, Nature Cure Plus Specific Group and Nature Cure Group

Variable	Source	df	SSx	SSy	MSSx	MSSy	F ratio (x)	F ratio (y)
HbA1c	B	2	1.16	0.60	0.58	0.30	6.52*	4.23*
	W	42	3.74	3.00	0.09	0.07		
	B	2	1.16	0.60	0.83	0.01	0.01	
	W	42	3.74	3.00	0.09	0.07		
	B	2	1.16	0.60	0.83	0.01	0.01	0.39
	W	41	3.74	3.00	2.90	0.75	0.02	

The table value required for significance at 0.05 levels for df 2 and 41 is 3.22 The table value required for significance at 0.05 levels for df 2 and 42 is 3.23

Table 4 shows that the obtained 'F' ratio value of 6.52 for the pres test means of Control, Nature Cure Plus Specific Group and Nature Cure Group on HbA1c rate is more than the required table value of 3.22 for significance for degrees of freedom 2 and 41 and 0.05 level of confidence . This indicates that there was significant difference in Glycosylated Hemoglobin among Control Group and Experimental Groups before training.

The obtained 'F' ratio value of 4.23 for post test mean of Control, Nature Cure Plus Specific Group and Nature Cure Group on HbA1c rate is more than the required table value of 3.22 for significance for degrees of freedom 2 and 41 and 0.05 level of confidence. This indicates that there was significant difference in Glycosylated Hemoglobin among Control Group and Experimental Groups after training.

Table 4 shows that the obtained 'F' ratio value of 0.39 of adjusted post test scores on Glycosylated Hemoglobin of Control, Nature Cure Plus Specific Group and Nature Cure Group were less than the required table value of 3.226 with degrees of freedom 2 and 41 at 0.05 level of confidence. This indicates that there was no significant difference in Glycosylated Hemoglobin among Control, Nature Cure Plus Specific Group and Nature Cure Group as a result of training.

Fasting Blood Sugar

Fasting Blood Sugar

The results of the dependent 't' test on the pre test and post test data obtained for Fasting Blood Sugar of the Control Group, Nature Cure Plus Specific Group and Nature Cure Group are presented in Table 5

Table 5

Dependent T Test for Pre Test and Post Test on Fasting Blood Sugar(FBS) of Control Group, Nature Cure Plus Specific Group and Nature Cure Group

Test	FBS	CG	NCPSG	NCG
Pre test	Mean	126.93	185.67	185.47
	SD	1.79	29.67	30.90
Post test	Mean	128.87	154.40	171.93
	SD	2.75	30.96	32.64
t test		2.28*	2.82*	1.17

*significant at 0.05 level

Table value 5 shows that the pre test means of Fasting Blood Sugar of Control Group, Nature Cure Plus Specific Group and Nature Cure Group are 126.93, 185.67 and 185.47 respectively. The post test means of Fasting Blood Sugar are 128.87, 154.40 and 171.93 respectively. The obtained 't' ratio value between the pre test and post test means on Fasting Blood Sugar are 2.28, 2.82 and 1.17 respectively. The table value required for significant difference for degrees of freedom 14 at 0.05 level is 2.14. It was concluded that the Control Group and Nature Cure Plus Specific Group have registered significant difference in Fasting Blood Sugar levels.

The data collected prior to and post experimental period on Fasting Blood Sugar of Control Group, Nature Cure Plus Specific Group and Nature Cure Group were statistically analyzed by analysis of variance to assess whether any significant difference existed among the Groups; before and after training and analysis of covariance to find out the effect of training and is presented in Table 6

Table 6

Analysis of Variance and Co-Variance on Fasting Blood Sugar (FBS) of Control Group, Nature Cure Plus Specific Group and Nature Cure Group

Variable	Source	df	SSx	SSy	MSSx	MSSy	F ratio (x)	F ratio (y)
FBS	B	2	34378.98	14070.53	17189.49	7035.27	28.06*	10.39*
	W	42	3.74	3.00	0.09	0.07		
	B	2	34378.98	14070.53	20084.93	5084.33	2542.16	55.78*
	W	41	25730.00	28448.27	26150.33	1868.73	45.58	

The table value required for significance at 0.05 levels for df 2 and 41 is 3.22 The table value required for significance at 0.05 levels for df 2 and 42 is 3.23

Table 6 shows that the obtained 'F' ratio value of 28.06 for the pre test means of Control Group, Nature Cure Plus Specific Group and Nature Cure Group on Fasting Blood Sugar rate is higher than the required table value of 3.22 for significance for degrees of freedom 2 and 41 at 0.05 level of confidence. This indicates that there was significant difference in Fasting Blood Sugar among Control Group and Experimental Groups before training.

The obtained 'F' ratio value of 10.39 for the post test means of Control Group, Nature Cure Plus Specific Group and Nature Cure Group on Fasting Blood Sugar rate is more than the required table value of 3.22 for significance for degrees of freedom 2 and 41 at 0.05 level of confidence. This indicates that there was significant difference in Fasting Blood Sugar among Control Group and Experimental Groups after training.

Table 6 shows that the obtained 'F' ratio value of 55.78 of adjusted post test scores on Fasting Blood Sugar of Control Group, Nature Cure Plus Specific Group and Nature Cure Group were higher than the required table value of 3.23 with degrees of freedom 2 and 41 at 0.05 level of confidence. This indicates that there was significant difference in Fasting Blood Sugar among the adjusted post test means of Control Group, Nature Cure Plus Specific Group and Nature Cure Group. To determine which of the paired means had a significant improvement, Scheffe's test was applied. The results of the test are presented in Table 7

Table 7

Scheffe's Post Hoc Test for the Difference between the

Adjusted Post Test Mean on Fasting Blood Sugar

Variable	CG	NCPSG	NCG	Mean	Confidence Interval
Fasting B Sugar	89.14		152.17	63.03*	5.28
	89.14	134.43		45.30*	5.28
		134.43	152.17	17.74*	5.28

Table 7 shows that the adjusted post test means between Control Group and Nature Cure Plus Specific Groups was 63.03 which were significant at 0.05 level of confidence. The adjusted post test means between Control Group and Nature Cure Groups was 45.30 which were significant at 0.05 level of confidence. The adjusted post test mean between Nature Cure Plus Specific and Nature Cure Groups was 17.74 which were significant at 0.05 level of confidence.

It is inferred from the results of the study that the Fasting Blood Sugar levels of Nature Cure Plus Specific and Nature Cure Group significantly reduced when compared to Control Group. The reduction in Fasting Blood Sugar levels was more prominent in Nature Cure Group.

Discussion on Findings

Glycosylated Hemoglobin

- The study shows that Nature Cure and Nature Cure Plus Specific Group registered significant decrease in Glycosylated Hemoglobin denoted by the significant change in the pre test and post test means.
- In patients with type 2 diabetes, significant improvement in A1C value and better glycemic control could be achieved by a regular exercise program as an intervention (Yavari et.al 2010).
- A 2006 meta-analysis composed of 27 studies found exercise to be associated with a mean reduction in HbA_{1c} of 0.80% with no difference in magnitude of change in HbA_{1c} between aerobic, resistance, and combination training.
- However Nature Cure programmes and Nature Cure Plus Specific programmes for twelve weeks could not significantly reduce Glycosylated Hemoglobin.The precise mechanism could not be ascertained. However significant reduction in Glycosylated Hemoglobin was noted in the study conducted by Yavari A.et al (2015).

Fasting Blood Sugar

The Fasting Blood Sugar levels of Nature Cure Plus Specific and Nature Cure Group significantly reduced when compared to Control Group. The reduction in Fasting Blood Sugar levels were more prominent in Nature Cure Group.

- Circulating glucose is routed into working skeletal muscle through several complementary mechanisms. Contraction of skeletal muscle stimulates glucose transport and metabolism into working muscle through an insulin-independent pathway. Exercise has additional effects that enhance the ability of insulin to activate glucose transport into muscles that have exercised; this effect can persist for many hours after physical activity has ceased. The delivery of glucose to working muscle is facilitated by increased blood flow to exercising muscles. When aerobic exercise is repeated on a regular basis (ie. training), muscles recruited by the training stimulus undergo additional adaptations that involve the synthesis of key components needed for glucose uptake and metabolism (e.g., the GLUT4 glucose transporter and enzymes, such as hexokinase, that Control the uptake and metabolism of glucose in muscle).
- These responses to exercise facilitate the clearance of glucose from the circulation and the metabolism of glucose in exercised skeletal muscle (oxidation during exercise; resynthesis of glycogen stores after exercise has been completed). In people with diabetes, plasma glucose levels decrease during and shortly after a bout of exercise. Indexes of long-term glycemic control, such as glycosylated hemoglobin (HbA1c, the level of which is elevated in diabetes), are improved (i.e., lowered) when exercise is performed regularly.

- Several factors may contribute to the improvement in glycemic control seen with resistance exercise training programs: (1) increases in muscle mass, which provide a larger reservoir for glucose disposal; (2) direct effects on skeletal muscle that increase glucose transport activity; and (3) improvements secondary to a loss of adipose tissue (in particular, visceral adipose tissue, which is known to be a contributor to insulin resistance). Determining the relative contributions of each of these factors is challenging.

Conclusions

1. There was no significant difference in Glycosylated Hemoglobin of Nature Cure Group and Nature Cure Plus Specific Group when compared to Control Group after training.
2. Fasting Blood Sugar level decreased in Nature Cure Plus Specific Group and Nature Cure Group as compared to Control Group after training.

References

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