VIMS Journal of Physical Therapy

[ORIGINAL ARTICLE]

Effect of 3 Months structured aerobic exercises versus structured resistance exercises programme on blood sugar level in type 2 Diabetes Mellitus- A randomized controlled trial

Mendhe Kiran[1], **Kumar Pravin**[2],
[1]Associate Professor, [2]Professor, V.S.P.M's College of Physiotherapy, Nagpur

ABSTRACT :

Background: There has been a burgeoning interest in quality of life issues in people with diabetes mellitus. The proposed study would be carried out to see which exercise programme would be more effective in glycemic control and improving quality of life after 3 months in patients suffering from type 2 diabetes mellitus.

Method: 60 patients were recruited and were divided into 2 groups. The first group received aerobic exercise training and the second group received resistance training exercise for 3 months. Pre and post-test values were evaluated for HbA1c%, Fasting blood sugar and post prandial blood sugar.

Result: The study shows that after 3 months of training the HbA1c %, fasting and post prandial bold sugar values of both the groups showed a very minimal difference between the two groups.

Conclusion: The study shows that either of the exercises can reduce the glycaemic levels of the blood after 3 month thus making these exercises helpful in type 2 diabetes mellitus patients.

Keywords: Type 2 diabetes mellitus, resistence exercises, aerobic exercises, HbA1c%,fasting blood sugar, post prandial blood sugar

Introduction:

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces.[1]. Globally, an estimated 422 million adults are living with diabetes mellitus, according to the latest 2016 data from the World Health Organisation (WHO). Diabetes is now a disease that affects 371 million people worldwide and 187 million of them do not even know they have the disease, according to the international diabetes federation (IDF).[2]

The number is projected to almost double by 2030. Type 2 diabetes makes up about 85-90% of all cases. Increase in the overall diabetes prevalence rate largely reflect an increase in risk factor for type 2, longevity and being overweight or obese until recently, India had more diabetic that any other country in the world, according to the international diabetes foundation.[2] Diabetes currently affects more than 62 million Indians, which is more than 7.1% of the adult population. The average age on onset is 42.5 years. The weighted prevalence of diabetes in Maharashtra is 8.4%. [3]

Various strategies exist for diabetes management which includes education nutrition physical activity smoking cessation, psychosocial care and immunization, lifestyle and behavioral modification.[2]

Resistance exercise is any form of active exercise in which dynamic or static muscle contraction is resisted by an outside force applied manually or mechanically. Resistance exercise also referred as resistance training.[4,5]

Aerobic exercise training is defined as a structured exercise program that involves the use of large muscle groups for extended periods of time in activities that are rhythmic in nature, including but not limited to walking, stepping, running, swimming, cycling and rowing.[4,5]

*Corresponding author
Mendhe Kiran
Email : kjanbandhu@yahoo.co.in
Associate Professor, VSPM College of Physiotherapy, Nagpur

Exercise is considered a corner stone of treatment for type 2 diabetes alongside diet and medication of proven efficacy. Although the effectiveness of exercise in improving glycemic control, blood lipid profiles and other outcomes in this group is well documented, there is less certainty about the relative effects of different types of exercise. Aerobic exercise is traditionally the most studied exercise, which recruits large groups of muscles and include brisk walking, cycling, swimming and jogging. However, 80 percent of people with type 2 diabetes are overweight or obese and may have mobility problems, peripheral neuropathy, visual impairments or cardio vascular disease. For these patients it may be infeasible to achieve the required volume and intensity of aerobic exercise and resistance exercise may be more feasible.[6]

Resistance exercise uses muscular strength to move a weight or to work against a resistive load, causing isolated, brief activity of single muscle groups and has received increasing attention in the last decade. There is a growing body of clinical evidence to support resistance exercise for those with type 2 diabetes indeed, most guideline recommend both aerobic and resistance exercise for people with type 2 diabetes mellitus. However, lack of adherence to the recommendation is a concern because even in research settings where people are instructed to follow just one type of exercise, the rate of regular exercise participation has been low and adherence to exercise protocol on ongoing problem. Possible reasons for this include personal preference, physical limitations and available facilities. Thus for patients who are able to follow just one type of exercise, it would be important to know which type of exercise is more effective and/or safe. Previously, some studies have evaluated the efficacy of aerobic and resistance exercises respectively, that compared either exercise with control. [6]

In 1997, the World Health Organisation (WHO) introduced the first definition of health as “A state of complete physical, mental and social well- being not merely the absence of disease”. WHO defined QOL as individual"s perception of position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations standards and concerns. Therefore except physical health definition of QOL includes psychological state, level of person"s independence, social life and personal belief. Resistance and aerobic exercises are both recommended as effective treatment for people with type 2 diabetes mellitus. However, the optimum type of exercise for the disease remain to be determined to inform clinical decision making and facilitate exercise prescription.[7,8,9]

Achieving and maintaining appropriate plasma glucose levels is vital to managing diabetes and this has traditionally been achieved using medication, dietary intervention and aerobic exercise. Muscle weakness, decreased muscle mass and changes in skeletal muscle fiber are related to compromised glycemic control in diabetes.[10] Skeletal muscle is a large reservoir for glucose disposal in the body and exercise is a powerful stimulant of glucose uptake partly to the action of the skeletal muscle glucose transporter protein. Therefore, resistance exercise with its direct effect on skeletal muscle may have a role in the management of patients with type 2 diabetes.[10]

Diabetes is connected with vascular complications and in international and national guidelines the overall goal for the treatment of all diabetes is to prevent acute and chronic complications while preserving a good quality of life for the patient.[11,3] PDQ is a disease specific scale this study will include PDQ score to assess quality of life (QOL). It is proved that it is a reliable and valid scale.(12) No known research has been conducted on the long term efficacy, retention and adherence of resistance training program in type 2 diabetes and there is a need for research to examine this question. Literature is minimal available for comparison between structured resistance exercise and structured aerobic exercise aimed immediately, short term and longterm duration especially in type 2 diabetes mellitus. Hence, the proposed study would be carried out to see which among these two would be more effective in glycemic control and improving quality of life at variable periods of time in patients suffering from type 2 diabetes mellitus[13].

Materials and method:

It was a Randomized controlled trial, in a Tertiary care hospital, with the study population of type 2 Diabetes Mellitus. Convenient sampling was used with a total sample size of 60 individuals. The time duration of the study was 18 months. The inclusion criteria was - 1) Sedentary patients with type 2 diabetes> I year, 2) Both genders, 3) Age:30-60 years, 4) All the patients were screened and stress

testingwas done under diabetologist supervision.5) Blood glucose levels– a.fasting blood glucose 126 mg/dl or greater, b.post prandial 200 mg/dl or greater, 6) Rate of perceived exertion was considered using Modified Borg rating scale of 0-10 (4 which is somewhat hard), and 7) Sedentary, defined as reporting never having participated in a structured exercise program or recreational physical activities or sport. The individuals were excluded by following criteria - 1) Smoking, 2) History Of Coronary Artery Disease, 3) Renal Impairment OrProtienuria, 4) Hepatic Impairment, 5) Gout Or Hyperuricaemia, 6) Uncontrolled Hypertension (Systolic Blood Pressure More Than 160 Mm Hg), 7) Diabetic Neuropathy, 8) Retinopathy, and 9) Any Complaint Secondary To Diabetes Mellitus.

Method :

Requisite permission was obtained. Ethical clearance was obtained. Subjects fulfilling the criteria were included. Written consent was obtained. Test protocol was explained to patients. Demographic data was collected. The information of patients on demographic variables was gathered. Data was collected from every patient enrolled for the study.Data was entered and coded in MS-Excel worksheet. Data was analyzed in statistical software STATA version 10.1 Data cleaning was employed using epi info software if and when required before final analysis of data. Data was summarized using descriptive statistic like mean and SD for quantitative variablei.e. HbA1c %,FastingBlood Glucose, PostPrandialBlood Glucose. Interferential statistical procedure was used for testing primary and secondary hypothesis. Test of significance like t-test for 2 independent samples, paired t-test chi-square test was used for comparing change form baseline between the group and within the group changes in main outcome variables.

Results:

The given study consists of 60 participants. Out of which 30 were included in group given aerobic exercise training and 30 were included in group given resistance exercise training. In the study out of 60 participants 37 were male and 23 were female. The study shows that after 3 months of training the HbA1c % values of both the groups i.e., aerobic exercise training group and resistance exercise training group showed -0.876 of difference between the two mean and p-value was 0.385. Fasting blood sugar levels also showed the decline after the training with the mean difference of -0.878 between the two groups and p-value as 0.383. And the post prandial blood sugar levels also showed the decrease in their levels after the 3 months training with mean difference of -0.899 between the two groups and p-value was 0.372. The p-value of all the variables was not statistically significant post exercise training for both the groups.

Table 1: Between group comparison of pre-test values of HbA1c%, Fasting blood sugar and post prandial blood.

	Group	Mean	Std. deviation	t-value	p-value
HbA1c% PRETEST	1	6.63	0.615	−0.625	0.535
	2	6.72	0.461		
Fasting blood sugar (PRETEST)	1	161.37	15.108	−0.366	0.716
	2	162.67	12.254		
Post prandial blood sugar (PRETEST)	1	308.37	31.512	−0.461	0.646
	2	312.73	41.188		

Table 2: Between group comparison of post-test values of HbA1c%, Fasting blood sugar and post prandial blood.

	Group	Mean	Std. deviation	t-value	p-value
HbA1c%	1	6.43	0.568	−0.876	0.385
	2	6.55	0.487		
Fasting blood sugar	1	148.83	14.904	−0.878	0.383
	2	151.93	12.312		
Post prandial blood sugar	1	288.93	36.915	−0.899	0.372
	2	297.87	39.964		

Table 3 : Pre and post-test values of HbA1c%

	Group 1	Group 2
HbA1c% PRE-TEST	6.63	6.72
HbA1c% POST-TEST	6.43	6.55

GRAPH 1: Between group comparison of pre and post-test values of HbA1c%

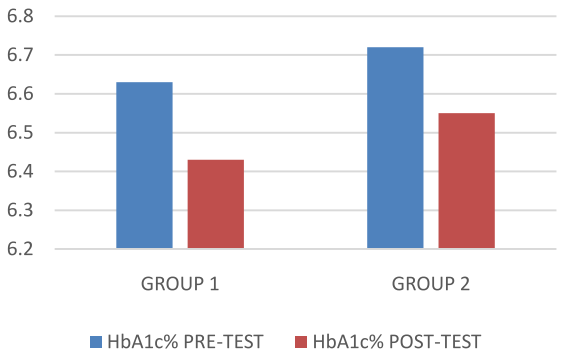


Table 4: Between group comparison of pre and post-test fasting blood sugar levels

	Group 1	Group 2
Fasting blood sugar (PRE-TEST)	161.37	162.67
Fasting blood sugar (POST-TEST)	148.83	151.93

GRAPH 2: Between group comparison of pre and post-test fasting blood sugar levels

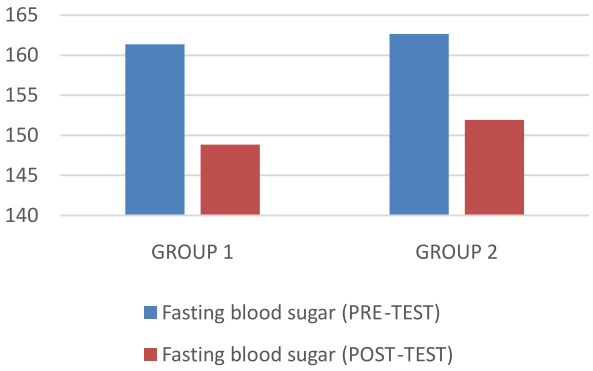
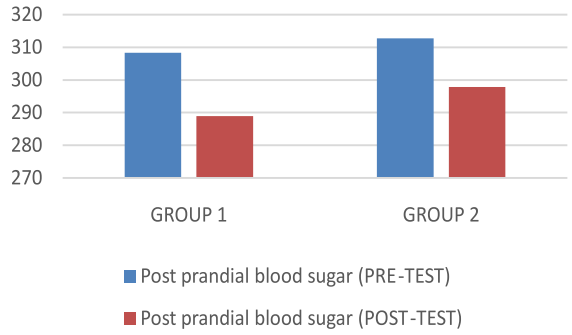


Table 5: Between group comparison of pre and post-test post prandial blood sugar levels

	Group 1	Group 2
Post prandial blood sugar (PRE-TEST)	308.37	312.73
Post prandial blood sugar (POST-TEST)	288.93	297.87

GRAPH 3: Between group comparison of pre and post-test post prandial blood sugar levels



Discussion:

The study consists of 60 participants out of which 37 were male and 23 were female. The study showed that there was a decrease in the values of HbA1c % post exercise in participants given aerobic exercise training. Also, there was a decrease in the HbA1c % values in participants given resistance exercise training. Exercise-induced improvements in glycemic control were greater among persons with higher baseline hemoglobin A1c values.

A study by Ronald J.Sigalet. al. also showed the that there is a slight decrease in the values of glycated haemoglobin in patients given with aerobic as well as resistance exercise training. The study also showed that there is decrease in the fasting as well as post prandial blood sugar levels post exercise but with very little levels in both the groups. The similar results were also seen in the study by Ronald J.Sigalet. al. The resistance training programs have been reported to have significant effects on daily energy expenditure, body composition and insulin sensitivity.[3]

The study shows that as compared to aerobic exercise training the resistance exercise training group shows a slightly more decrease in the values of all variables. Although the difference was not that significant so both types of exercise is considered to be of equal importance in reducing blood glycaemic levels. Both resistance and aerobic exercise protocols were effective in reducing pre- and post-exercise blood glucose levels and HbA1c levels, but resistance exercise produced a more significant reduction in HbA1c level was seen in the study by Salameh Bweir [11], et. al., Similar result was shown in the study by Ronald J.Sigalet. al. where he concluded that the training will be more effective to reduce glycaemic levels if there is a combination of aerobic and resistance training is given to the patient.[8]

Conclusion:

The study shows that either of the exercises i.e., aerobic or resistance training can reduce the glycaemic levels of the blood after 3 month thus making these exercises more helpful in type 2 diabetes mellitus patients.

References:

1) Esteghamati A, Gouya MM, Abbasi M, Delavari A, Alikhani S, Alaedini F, Safaie A, Forouzanfar M, Gregg EW.Prevalence of diabetes and impaired fasting glucose in the adult population of Iran: National Survey of Risk Factors for Non-Communicable Diseases of Iran. Diabetes care. 2008 Jan 1;31(1):96-8
2) Anjana RM, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R, Bhansali A, Joshi SR, Joshi PP, Yajnik CS, Dhandhania VK.Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: Phase I results of the Indian Council of Medical Research–Diabetologia. 2011 Dec 1;54(12):3022-7
3) Kisner C, Colby LA, Borstad J. Therapeutic exercise: foundations and techniques. Fa Davis; 2017 Oct 18.
4) American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription. Lippincott Williams & Wilkins; 2013 Mar 4.
5) Yang Z, Scott CA, Mao C, Tang J, Farmer AJ. Resistance exercise versus aerobic exercise for type 2 diabetes: a systematic review and meta-analysis. Sports medicine. 2014 Apr 1;44(4):487-99
6) Lillioja S, Wilton A. Agreement among type 2 diabetes linkage studies but a poor correlation with results from genome-wide association studies. Diabetologia. 2009 Jun 1;52(6):1061-74
7) Snowling NJ, Hopkins WG. Effects of different modes of exercise training on glucose control and risk factors for complications in type 2 diabetic patients: a meta-analysis. Diabetes care. 2006 Nov 1;29(11):2518-27
8) Tokmakid is SP, Zois CE, Volaklis KA, Kotsa K, Touvra AM. The effects of a combined strength and aerobic exercise program on glucose control and insulin action in women with type 2 diabetes. European journal of appliedphysiology. 2004 Aug 1;92(4-5):437-42
9) Irvine C, Taylor NF. Progressive resistance exercise improves glycaemic control in people with type 2 diabetes mellitus: a systematic review. Australian Journal of Physiotherapy. 2009 Jan 1;55(4):237-46
10) Jovita DA, Venkateswarlu K, Clifford EC. Effect of Aerobic Dance Exercise on Blood Pressure of Normotensive Pregnant Women Diagnosed with Gestational Diabetes at Federal Medical Centre, Owerri, South East Nigeria. Indian Journal of Physiotherapy and Occupational Therapy-An International Journal. 2015;9(4):124-8
11) Stetson B, Schlundt D, Rothschild C, Floyd JE, Rogers W, Mokshagundam SP. Development and validation of The Personal Diabetes Questionnaire (PDQ): a measure of diabetes self-care behaviors, perceptions and barriers. diabetesresearch and clinicalpractice. 2011 Mar 1;91(3):321-32.
12) Eves ND, Plotnikoff RC. Resistance training and type 2 diabetes: considerations for implementation at the population level. Diabetes care. 2006 Aug 1;29(8):1933-41