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# INVESTIGATION OF THE CHANGES ON BLOOD SUGAR IN RESPONSE TO AEROBIC AND ANAEROBIC TRAINING AMONG TYPE 2 DIABETIC PATIENTS

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***ABSTRACT***

*The purpose of the study is to investigate the changes on blood sugar in response to aerobic and anaerobic training among type 2 diabetic patients. To achieve the purpose of the study 45 male type 2 diabetic patients from Ongole, in the southern part of Andhra Pradesh, India, were selected as subjects. The subjects were selected in the age group of 45 to 50 years and they were randomly assigned into three equal groups of 15 each. Experimental group-I was given the packages of aerobic training, experimental group-II was given the packages of anaerobic training and group III acted as control. Control group was restricted to participate in any specific training. The blood sugar was selected as dependent variable. The data collected from the experimental and control groups on selected dependent variable was statistically analyzed by paired 't' test to find out the significant differences if any between the pre and post test. Further, percentage of changes was calculated to find out the chances in selected dependent variable due to the impact of experimental treatment. The data collected from the three groups prior to and post experimentation on selected dependent variable was statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Whenever the obtained 'F' ratio value was found to be significant for adjusted post test means, the Scheffe's test was applied as post hoc test. In all the cases the level of confidence was fixed at 0.05 level for significance. The result of the reveals that due to the effect of aerobic and anaerobic training the fasting blood sugar of the diabetic patients is significantly reduced. It is also concluded that no significant differences existed between aerobic and anaerobic training groups in altering fasting blood sugar.*

**Key Words:** *Aerobic training, Anaerobic training and Blood sugar.*

## INTRODUCTION

In India the diabetic population was rapidly increasing with 30 million diabetic patients, the largest in the world. Forty percent of all diabetic admissions to hospitals in India are due to lack of exercises. Research showed that physical exercises have been shown to reduce cholesterol levels, have a protective effect from coronary heart disease, reduce body weight, reduce blood pressure and improve circulation in diabetic patients. For decades, exercise has been considered a cornerstone of diabetes management, along with diet and medication. However, high-quality evidence on the importance of exercise and fitness in diabetes was lacking until recent years.

Exercise is widely prescribed in developed countries as a lifestyle intervention to control glucose and blood pressure (BP) in type 2 diabetic patients (Segal et al., 1991; Krotkiewski, Lonnroth. & Mandroukas, 1991; Lee et al., 2005; Dela et al., 1994). Because of their inherent daily physical activity in developing countries, exercise is seldom prescribed to patients with type 2 diabetes. Therefore, little is known if a structured exercise program added to an already active lifestyle would affect blood sugar in this population with type 2 diabetes.

Regular exercise is an important modality in the treatment of type 2 diabetes. Most studies of exercise training in patients who had diabetes were concerned with cardiovascular health and weight control and less on its affect on coronary heart disease risk factors. Although it is well-established that exercise increases health related physical fitness components who have diabetes, the effects of exercise on coronary heart disease risk factors of cardiovascular structure and function in patients who have type 2 diabetes has not been examined fully. Physical exercises such as aerobic and anaerobic have been beneficial in keeping blood sugars in control for many patients.

There are two main types of exercises: aerobic exercise and anaerobic exercise. Aerobic exercise is physical activity that increases the activity of the pulmonary and cardiovascular systems. It requires an increase in oxygen to be used and transported to the muscle. Conversely, anaerobic exercise is physical activity of a short

duration and of less intensity than aerobic exercise. It does not require an increase in oxygen to be used and transported to the muscle. Physiological functions of the body may be improved by exercise.

Aerobic exercise and fitness can be contrasted with anaerobic exercise. The two types of exercise differ by the duration and intensity of muscular contractions involved, as well as by how energy is generated within the muscle. Because aerobic and anaerobic training focuses on very different results on the body, it is easy to assume that there are many different adaptations the body must make if one were to choose to only exclusively train aerobic or anaerobic. Therefore, in order for exercise physiologists and trainers to create successful training protocols, a more complete understanding of physical and physiological, bio-chemical responses to exercise is essential. To date, there has been a lack of research conducted to identify the cardiac risk factors to aerobic and anaerobic training that contribute to improved health condition of diabetic patients.

Through the study of science and various sports training, researchers have developed a greater understanding on how the human body reacts to exercise, training and many other stimuli. The effects of aerobic training and anaerobic training on cardiac risk factors are useful research objectives and it has drawn the attention of the investigator. Because, many have reduced their medication levels during their tenure in their exercise programme. Researches also proved that aerobic and anaerobic exercises significantly alter blood glucose, blood cholesterol, blood lipids and other benefits to different population. Thus, aerobic and anaerobic training places an important role in reducing the blood glucose level by increasing the level of secretion of insulin. The investigator in this research study interested to find out the relative effect of aerobic and anaerobic training on blood sugar among diabetic patients.

## METHODOLOGY

### Subjects and Variables

The purpose of the study is to investigate the changes on blood sugar in response to aerobic and anaerobic training among type 2 diabetic patients. To achieve the purpose of the study 45 male type 2 diabetic patients from Ongole, in the southern part of Andhra Pradesh, India, were selected as subjects. The subjects were selected in the age group of 45 to 50 years and they were randomly assigned into three equal groups of 15 each. Experimental group-I underwent aerobic training, experimental group-II underwent anaerobic training and group III acted as control. Control group was restricted to participate in any specific training. The purpose, nature and importance of experiment, the procedure to be employed in the collection of data, and the role of the subjects during experimentation and testing periods were explained to the subjects. The blood sugar was selected as dependent variable. Venous blood specimens were withdrawn after overnight fasting (12-14 hours. Glucose was estimated by the method of Trinder using reagent Kit (1969).

### Training Protocol

The training regimen for the two experimental groups lasted for twelve weeks for three days per week and one session of 60 minutes in the morning session. Experimental group-I underwent aerobic training, experimental group-II underwent anaerobic training and group-III was the control group who did not participate in any specialized training during the period of study. Before entering the study, all subjects were encouraged to follow a healthy diet, according to standard recommendations for diabetic subjects (American Diabetes Association. Standards of medical care in diabetes, 2011). Thereafter, patients were instructed to maintain their baseline calorie intake by consuming self-selected foods.

In this present investigation continuous running was given to the subjects as aerobic training. To fix the training load for the aerobic training group the subjects were examined for their exercise heart rate in response to different work bouts, by performing continuous running of two minutes duration for proposed repetitions and sets, alternating with active recovery based on work-rest ratio. The experimental group-II performed anaerobic training alternatively three days in a week for twelve weeks. The subjects were examined for their exercise heart rate in response to different anaerobic work bouts by the anaerobic exercise of 50 meters sprinting was performed for proposed repetitions and sets, alternating with rest time that enables complete recovery. The subject's both the experimental group's training zone was computed using Karvonen formula (Karvonen, Kentala & Mustala, 1957) and it was fixed at 60%HRmax to 85%HRmax. The work rest ratio of 1:1 between repetition and 1:3 between sets was given. Heart rate monitors were used to standardize exercise intensity (Polar S810i; Polar Electro, Kempele, Finland).

### Statistical Technique

The data collected from the experimental and control groups on blood sugar was statistically analyzed by paired 't' test to find out the significant differences if any between the pre and post test. Further, percentage of changes was calculated to find out the chances in selected dependent variables due to the impact of experimental treatment. The data collected from the three groups prior to and

post experimentation on blood sugar was statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Since three groups were involved, whenever the obtained 'F' ratio value was found to be significant for adjusted post test means, the Scheffe's test was applied as post hoc test. In all the cases the level of confidence was fixed at 0.05 level for significance.

**RESULT**

The descriptive analysis of the data showing mean and standard deviation, range, mean differences, 't' ratio and percentage of improvement on fasting blood sugar of experimental and control groups are presented in table-1

Table – 1: **Descriptive Analysis of the Pre and Post Test Data and 'T' Ratio on Fasting Blood Sugar of Experimental and Control Groups**

| Group | Test | Mean | Standard Deviation | Range | Mean Differences | 't' ratio | Percentage of Changes |
|---|---|---|---|---|---|---|---|
| Aerobic Training | Pre test | 137.33 | 6.10 | 20.00 | 7.40 | 11.73 | 5.39% |
| | Posttest | 129.93 | 4.57 | 17.00 | | | |
| Anaerobic Training | Pre test | 138.60 | 10.25 | 28.00 | 5.40 | 6.36 | 4.59% |
| | Posttest | 133.20 | 10.04 | 32.00 | | | |
| Control Group | Pre test | 140.07 | 13.81 | 37.00 | 1.80 | 6.08 | 1.29% |
| | Posttest | 141.87 | 14.17 | 39.00 | | | |

*Table t-ratio at 0.05 level of confidence for 14 (df) =2.15*
**Significant*

Table-1 shows that the mean, standard deviation, range and mean difference values of the pre and post test data collected from the experimental and control groups on fasting blood sugar. Further, the collected data was statistically analyzed by paired 't' test to find out the significant differences if any between the pre and post data. The obtained 't' values of aerobic training, anaerobic training and control groups are 11.73, 6.36 and 6.08 respectively which was greater than the required table value of 2.15 for significance at 0.05 level for 14 degrees of freedom. It revealed that significant differences exist between the pre and post test means of experimental group and control groups on fasting blood sugar.

The result of the study also produced 5.39% percentage of changes in fasting blood sugar due to aerobic training, 4.59% of changes due to anaerobic training and 1.29% of changes in control group. The pre and post test data collected from the experimental and control groups on fasting blood sugar is statistically analyzed by using analysis of covariance and the results are presented in table–2.

Table – 2; **Analysis of Covariance on Fasting Blood Sugar of Experimental and Control Groups**

| | Aerobic training Group | Anaerobic training Group | Control Group | S o V | Sum of Squares | Df | Mean squares | 'F' ratio |
|---|---|---|---|---|---|---|---|---|
| Pre test Mean | 137.33 | 138.60 | 140.07 | B | 56.13 | 2 | 28.07 | 0.25 |
| SD | 6.10 | 10.25 | 13.81 | W | 4661.87 | 42 | 111.00 | |
| Post test Mean | 129.93 | 133.20 | 141.87 | B | 1140.93 | 2 | 570.47 | 5.31* |
| SD | 4.57 | 10.04 | 14.17 | W | 4515.07 | 42 | 107.50 | |
| Adjusted Post test Mean | 131.21 | 133.26 | 140.53 | B | 710.98 | 2 | 355.49 | 59.49* |
| | | | | W | 245.00 | 41 | 5.98 | |

*Table F-ratio at 0.05 level of confidence for 2 and 42 (df) = 3.23, 2 and 41 (df) = 3.23*
**Significant*

Table-2 shows that the pre-test means and standard deviation on fasting blood sugar of aerobic training, anaerobic training and control groups are 137.33 $\pm$ 6.10, 138.60 $\pm$ 10.25 and 140.07 $\pm$ 13.81

respectively. The obtained 'F' value 0.25 of fasting blood sugar is lesser than the required table value of 3.23 for the degrees of freedom 2 and 42 at 0.05 level of confidence, which proved that the random assignment of the subjects were successful and their scores on fasting blood sugar before the training were equal and there was no significant differences.

The post-test means and standard deviation on fasting blood sugar of aerobic training, anaerobic training and control groups are 129.93 ± 4.57, 133.20 ± 10.04 and 141.87 ± 14.17 respectively. The obtained 'F' value of 5.31 on fasting blood sugar was greater than the required table value of 3.23 at 2, 42 df at 0.05 level of confidence. It implied that significant differences exist between the three groups during the post test on fasting blood sugar.

The adjusted post-test means on fasting blood sugar of aerobic training, anaerobic training and control groups are 131.21, 133.26 and 140.53 respectively. The obtained 'F' value of 59.49 on fasting blood sugar was greater than the required table value of 3.23 of 2, 42 df at 0.05 level of confidence. Hence, it was concluded that significant differences exist between the adjusted post test means of aerobic training, anaerobic training and control groups on fasting blood sugar. Since, the obtained 'F' value in the adjusted post test means was found to be significant, the Scheffe's test was applied as post hoc test to find out the paired mean difference, and it is presented in table-3

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Table -3: **Scheffe's Post Hoc Test for the Differences among Paired Means of Experimental and Control Groups on Fasting Blood Sugar**

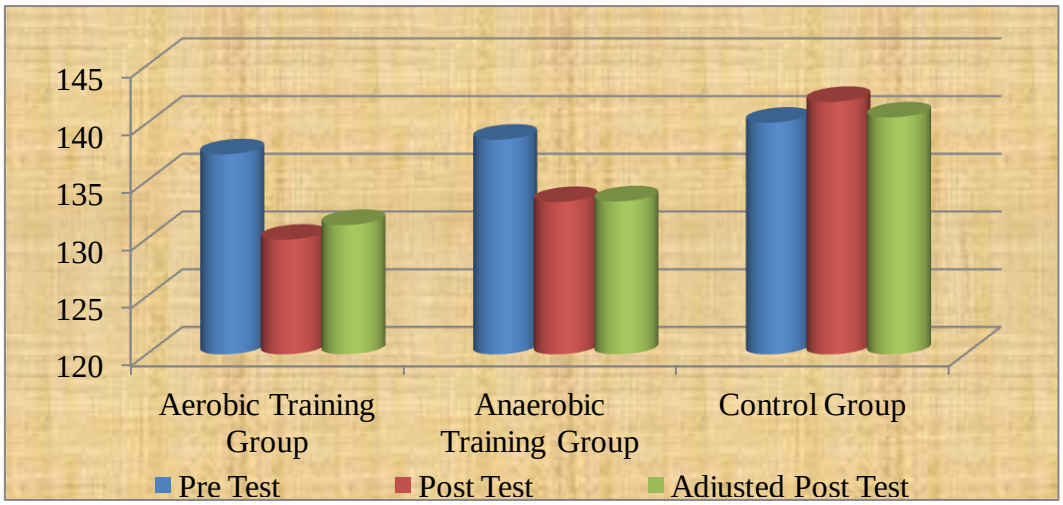
| Aerobic Training | Anaerobic Training | Control Group | Mean Difference | Confidence Interval |
|---|---|---|---|---|
| 131.21 | 133.26 | | 2.05 | 2.27 |
| 131.21 | | 140.53 | 9.32* | 2.27 |
| | 133.26 | 140.53 | 7.27* | 2.27 |

**Significant at 0 .05 level*

As shown in table-3 the Scheffe's post hoc analysis proved that significant mean differences existed between aerobic training and control groups, anaerobic training and control groups on fasting blood sugar. Since, the mean differences 9.32 and 7.27 are higher than the confident interval value of 2.27 at 0.05 level of significance. However, no significant mean differences existed between aerobic training and anaerobic training groups, since, the mean differences 2.05 is lesser than the confident interval value of 2.27 at 0.05 level of significance.

Hence, it is concluded that due to the effect of aerobic training and anaerobic training the fasting blood sugar of the subjects was significantly changed. It is also concluded that no significant differences existed between aerobic training and anaerobic training groups in altering fasting blood sugar. The pre, post and adjusted post test mean values of experimental and control groups on fasting blood sugar is graphically represented in figure-1.

Figure – 1: **Bar Diagram Showing the Mean Values on Fasting Blood Sugar of Experimental and Control Groups**



## DISCUSSION

Exercise and diet are considered the cornerstones of diabetes treatment (Praet & van-Loon, 2008; Magkos *et al.*, 2009). Indeed, several studies have demonstrated that exercise alone has clinical benefits, such as improved insulin sensitivity, reductions in glycated hemoglobin (A1c) and increased peak oxygen consumption ($VO_{2peak}$) (Zanuso, et al., 2010; Dunstan et al., 2002; Boule et al., 2001; Praet & van Loon, 2009). The mechanism by which exercise improves insulin sensitivity is well documented (Richter et al., 1989). Sigal et al. (2007) reported a similar mean $HbA_{1c}$ reduction after aerobic training, by 0.51%. On the other hand, Church et al. (2010) reported negligible $HbA_{1c}$ changes after 1 year of aerobic training.

Exercise training had little impact on resting plasma glucose (Kelley & Goodpaster, 2001), but response to the glucose challenge was attenuated, while the CON group demonstrated no change, suggesting that additional exercise in physically active individuals can enhance glucose control. Thus, data show glucose tolerance was improved with a specific exercise training program in already active individuals with type 2 diabetes. Further research is needed to identify the mechanisms mediating the differential responses. This study has demonstrated that adding a structured exercise intervention to type 2 diabetes patients helps to control coronary heart disease risk factors over 12 weeks. Thus additional exercise should be encouraged in those individuals who appear to have adequate physical activity levels. Exercise training can be viewed as beneficial on its own, independent of weight loss.

## CONCLUSION

It is concluded that due to the effect of aerobic training and anaerobic training the fasting blood sugar of the diabetic patients was significantly changed. It is also concluded that no significant differences existed between aerobic training and anaerobic training groups in altering fasting blood sugar. The result of the study produced 5.39% percentage of changes due to aerobic training and 4.59% of changes due to anaerobic training in fasting blood sugar of the type 2 diabetic patients.

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