COMPARISON OF RESISTANCE EXERCISE VS AEROBIC EXERCISE IN PATIENTS WITH TYPE II DIABETES MELLITUS

Vijayakumar M¹, Tushar J Palekar, ²

1. Vijayakumar M, Associate Professor, Padmashree Dr.D.Y.Patil College of Physiotherapy, Dr. D.Y.Patil Vidyapeeth, Pune, Maharastra, India -411018.

2. Tushar J Palekar, Principal & Professor, Padmashree Dr.D.Y.Patil College of Physiotherapy, Dr. D.Y.Patil Vidyapeeth, Pune, Maharastra, India -411018.

Abstract

Background: Diabetes mellitus is one of the oldest diseases known to men. It was described in India in 400 B.C. It is one of the major health problems facing our nation as well as other industrialized western countries whose prevalence is increasing day by day. Aerobic exercises are useful for type II DM by increasing peripheral insulin sensitivity but they are useful for controlling it as a long term treatment. Purpose of study: If they produce any short term effects in DM II patients then it will be useful for them to controlling it immediately and it would be easy to proceed forward for any operative procedure. Methodology: Aiming to compare the effects of resisted exercise and aerobic exercise on blood glucose level in a single session, an Experimental study, at Dr. D .Y. Patil Medical college Hospital and research center, Pimpri, Pune, was done targeting Type II DM patients, by Purposive sampling of 100 samples, between Age 40 – 60 year type II DM patients having equal share of both sex, who were Diagnosed as type II DM; RBS > 150 mg/dl, FBS >125 mg/dl, and Willing to participate. 2 groups of 40 -60 years type II DM patents received aerobic exercise and resisted exercise according to the distribution. 30 subjects were selected for resisted exercise and 30 for aerobic exercise. Procedure: Before starting exercise session blood glucose was checked by using standardized glucometer. Both groups received 10 minutes of warm up which include 4 minutes of stretching of the large muscles (quadriceps, hamstring, calf), 3 min low intensity cycling and 3 min low intensity treadmill. During warm up procedure patients’ RPE should be light that is 7 to 9 on borg’s rating scale of perceived exertion. Data & Results: Comparison of blood sugar levels pre- exercise, immediate post – exercise, post 1 hr, post 2 hr after aerobic exercises, group 1, showed that Blood sugar level is elevated highest immediately post exercise and returns back to pre – exercise levels at the end of 2 hrs and group 2 showed The blood sugar level is elevated highest immediately post exercise and returns back to pre- exercise level by the end of 2 hrs. Conclusion:- Thus aerobic training and resistance training alone each led to improvements in glycemic control. These effects were more powerful among individuals with poor glycemic control at baseline. Therefore, persons with type 2 diabetes who wish to improve their metabolic control through physical activity should be encouraged to perform both aerobic and resistance training.
Introduction:

Diabetes mellitus is one of the oldest diseases known to men. It was described in India in 400 B.C. It is one of the major health problems facing our nation as well as other industrialized western countries whose prevalence is increasing day by day.

There are mainly 2 type of DM.
1) IDDM – Type I DM
2) NIDDM – Type II DM

The other types of DM are gestational DM which occurs in pregnancy, malnutritional related DM and other specific type of DM associated with various medical conditions and syndromes. Among all, type II DM is very common which occurs after the age of 40 except in overweight children. It is an adult onset DM marked by decreased insulin sensitivity and overall poor glucose control. For type II DM there are many available treatment regimes. The universally accepted component of the non pharmacologic treatment for type II DM is exercise. As it is known aerobic exercise has been advocated for improving glucose control, although there is an increasing body of literature supporting for resisted exercise as a beneficial component in the management of type II DM. The benefits of resistance exercise are not limited to enhance blood glucose level but also it includes the maintenance and improvement of muscle strength. There are many studies done on effects of aerobic exercise in type II DM but there are less literature available for resisted exercise. Most of the studies have been done for long duration. It is not till now the immediate effects of both aerobic and resisted exercises.

Literature Review of Winnick JJ, et al\textsuperscript{2} states in their study “Short term aerobic exercise training in obese humans with type 2 diabetes mellitus improves whole-body insulin sensitivity through gains in peripheral, not hepatic insulin sensitivity” documented that Exercise training did not have an impact on peripheral glucose uptake or endogenous glucose production during the basal state or low-dose insulin. Likewise, it did not alter endogenous glucose production during high-dose insulin. However, 1-wk of exercise training increased both whole-body (P<0.05) and peripheral insulin sensitivity (P<0.0001) during high-dose insulin. Improvements to whole body insulin sensitivity after short-term aerobic exercise training are due to gains in peripheral, not hepatic insulin sensitivity. Shorr. I. etal\textsuperscript{3} in their study “Glycemic control of older adults with type 2 diabetes : Findings from the Third National Health and Nutrition Examination Survey, 1988-1994 “ concluded that Although many older adults with type 2 diabetes do not achieve
targets for glucose control, there is no evidence to suggest that community-dwelling older adults with diabetes are treated less vigorously than younger persons with diabetes. Thus the Need of the study arises whether Aerobic exercises are useful for type II DM by increasing peripheral insulin sensitivity but they are useful for controlling it as a long term treatment. There is no review available for their short term effects. So if they produce any short term effects in DM II patients then it will be useful for them to controlling it immediately and it would be easy to proceed forward for any operative procedure.

The study was aimed to compare the effects of resisted exercise and aerobic exercise on blood glucose level in a single session. To achieve it, it was decided to find the outcome of resisted exercise & aerobic exercise in type II DM separately and then to compare the effects of both type of exercises on blood glucose level and to know which is better in reducing blood glucose level.

The study was conducted at Dr. D.Y. Patil Medical college Hospital and research center, DR. D.Y.Patil Vidyappeth, Pimpri, Pune. An Experimental study design was adopted since the study included two different types of training methods to the selected population. 60 Type II DM patients between the Age 40 – 60 year type II DM patients having equal share of both sex, who were medically diagnosed as type II DM (RBS > 150 mg/dl, FBS >125 mg/dl) were selected randomly as the registration occurs, included with their written consent and were allotted to the two different groups by random allocation using chit methods.

Efforts were taken to ensure that Subjects who are doing regular exercises, Uncontrolled hypertensive patients, Diabetic neuropathy, Diabetic retinopathy, diagnosed for cardiac, musculoskeletal problem, Rheumatologic disease that affects mobility were excluded.

Procedure:
The subjects in both the groups received planned exercise programme in a single session for 1 hour. Subjects were ensured about the submission of the informed consent form before the study, and they are fit for the exercise training planned or the study. The selected participants were randomly allotted into 2 groups after checking all the inclusion and exclusion criteria. Before starting exercise session blood glucose was checked by using standardized glucometer. If patient was hypoglycemic at that time, 15 gm of carbohydrate was given and then 5 -10 min rest was given. After that again blood glucose level was checked. If it will come to its normal level then
only patient started exercising. Resting blood pressure was checked by using sphygmomanometer. It should be <140/90.

Both groups received 10 minutes of warm up which include 4 minutes of stretching of the large muscles (quadriceps, hamstring, calf), 3 min low intensity cycling and 3 min low intensity treadmill. During warm up procedure patients’ RPE should be light that is 7 to 9 on Borg’s rating scale of perceived exertion.

**Group 1:** After warm up group 1 performed exercise on treadmill. Patients were asked to walk on the treadmill for 50 min to 1 hour with their normal pace and to report if they feel any discomfort like nausea, chest pain uneasiness, headache, excessive sweating etc. during the procedure. Patient should not hold the treadmill bar and asked to walk with erect posture.

**Group 2:** After the warm up procedure group 2 performed resisted exercises for large muscle like quadriceps, hamstring, calf, gluteus maximus, medius, minimus. First 10 RM were checked for each muscle. 50% of the 10 RM was taken as the resistance for that particular muscle. Patient will receive circuit interval training. All the exercises were done by the patients are as follows: Squat with dumbbell, Leg press leg extension (80% 10 RM), Leg curl up (80% 10 RM), Resisted exercises at shoulder (80% 10 RM), Standing calf raise with weight stakes (80% 10 RM), Back kicks, Lunges & Bridging 15 repetitions were performed for each exercise at a stretch and 2 min rest period between 2 exercises will be given. Patient will perform these exercises for 50 to 60 min. patients will be asked for any discomfort during exercise.

For both the group immediate after the exercise session blood glucose level was checked by using the same glucometer. And for sustenance blood glucose level was checked after 1 hour and 2 hour. Data were collected and outcome measure was compared by using proper statistical method.
Data Analysis

Table 1: Comparison of blood sugar levels pre-exercise, immediate post – exercise, post 1 hr, 2 hr & 3 hr after resisted & aerobic exercises.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Schedule of BSL sample analysis</th>
<th>BSL – following Resisted exercises</th>
<th>BSL – following Aerobic exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pre exs.</td>
<td>143</td>
<td>147</td>
</tr>
<tr>
<td>2</td>
<td>Immediate post exs.</td>
<td>158.4</td>
<td>157.13</td>
</tr>
<tr>
<td>3</td>
<td>Post 1hr</td>
<td>120.7</td>
<td>123.5</td>
</tr>
<tr>
<td>4</td>
<td>Post 2 hr</td>
<td>112.3</td>
<td>119.6</td>
</tr>
<tr>
<td>5</td>
<td>Post 3 hr</td>
<td>114.6</td>
<td>119.8</td>
</tr>
</tbody>
</table>

Graph 1: Comparison of blood sugar levels pre-exercise, immediate post – exercise, post 1 hr, 2 hr & 3 hr after resisted & aerobic exercises.

Ref: Blood sugar level is elevated highest immediately post exercise and returns back to pre-exercise levels at the end of 1 hrs And & 2hrs below the pre exercising levels in resisted training group, than the aerobic exercise group.
Discussion

Our primary findings were that aerobic training and resistance training each improved glycemic control. Exercise-induced improvements in glycemic control were greater among persons with higher baseline hemoglobin A1c values.  

However, because the physiologic effects of aerobic training differ from those of resistance training, we cannot assume that our results reflect only additional exercise time. Aerobic training involves continuous activity of multiple large muscle groups, whereas resistance training involves isolated, brief activity of single muscle groups.  

Because of the need to rest between sets due to anaerobic metabolism in resistance training, less than half the time of each resistance exercise session involves active muscle contraction, whereas aerobic exercise is continuous. If our findings simply reflected duration of active exercise, we would expect that the effect of resistance training on hemoglobin A1c would be less than half that of aerobic training. Instead, the effects of aerobic training and resistance training on hemoglobin A1c were approximately equal. The effects of aerobic and resistance exercises on fitness are complementary: Aerobic exercise increases cardio respiratory fitness, whereas resistance training increases muscle strength and endurance.  

Our study participants were not adherent to exercise and not healthier on average than the general population. However, the number of individuals participating in our trial far exceeded the numbers recruited locally for any pharmaceutical trial, indicating that there is considerable interest in lifestyle interventions.  

In patients with type 2 diabetes, a single bout of aerobic- and resistance-type exercise has been shown to improve whole-body insulin sensitivity. However, a distinction should be made between the acute effects of exercise and training effects. During an acute exercise session, glucose uptake by the exercised muscle increases through several complementary mechanisms: contraction-induced (and insulin-independent) increase in the muscle glucose transporter system (GLUT-4), decreased muscle and liver glycogen stores, and increased skeletal muscle blood flow. These effects occur during the short term, and wear off between 2 and 14 hours after exercise completion. The gluco-regulatory benefit of either type of exercise training is the sum of the effects of each successive bout of exercise. In addition, more prolonged exercise training is accompanied by a more structural adaptive response in glucose transport and metabolism.
There are apparent differences in the long-term adaptive response to aerobic- or resistance-type exercise training. Prolonged aerobic-type exercise training has been shown to improve insulin sensitivity and insulin responsiveness. In this case, increased insulin sensitivity is attributed to the concomitant induction of weight loss, the up-regulation of skeletal muscle GLUT-4 expression, improved nitric oxide-mediated skeletal muscle blood flow, reduced hormonal stimulation of hepatic glucose production, and the normalization of blood lipid profiles. Long-term resistance-type exercise interventions have also been reported to improve glucose tolerance and/or whole-body insulin sensitivity and have been associated with a substantial gain in skeletal muscle mass, thereby improving whole-body glucose disposal capacity. More importantly, combined aerobic and resistance training reverses alterations in mitochondrial density and size in the activity of respiratory chain complexes and in cardio-lipin content. In patients with type 2 diabetes, restoration of mitochondrial function is paralleled by improved insulin-stimulated glucose disposal and by complete restoration of metabolic flexibility and insulin-stimulated substrate oxidation toward control values. It should be noted that the insulin-sensitizing effect of combined exercise training occurs in the absence of major changes in body mass and is not restricted to improved muscle insulin sensitivity but extends to improved hepatic and adipose tissue insulin sensitivity.

At the other end of the spectrum, emerging inactivity physiology studies suggest that inactivity initiates strong specific cellular responses, such as suppression of skeletal muscle lipoprotein lipase activity, which contributes to poor lipid metabolism that may negate the benefits of extra exercise. This suggests that any type of brief muscular contraction throughout the day, breaking sedentary time, may be necessary to short-circuit deleterious molecular signals causing metabolic disease.

In summary, aerobic training and resistance training alone each led to improvements in glycemic control. These effects were more powerful among individuals with poor glycemic control at baseline. Therefore, persons with type 2 diabetes who wish to improve their metabolic control through physical activity should be encouraged to perform both aerobic and resistance training.
Conclusion

Although exercise is widely accepted as a cornerstone of type 2 diabetes management, it is not easy to include and maintain in real-life conditions. Regular exercise significantly improves blood glucose control, reduces Cardiovascular risk factors, can contribute to weight loss, and has a positive impact on well-being. Structured single bout of exercise interventions have been shown to lower BSL by an average of 20%, in both groups. How ever the resisted exercise group show better utilization and long durational sustenance as compared to the aerobic group. This level of improved glycemic control is clinically relevant and compares well with the HbA1c reduction associated with improved morbidity and mortality outcomes. Higher levels of exercise intensity are associated with greater improvements in HbA1c and fitness. Thus we confirm that diabetic adults should have more than 30 minutes of moderate-intensity activity (eg, brisk walking) on most (ideally all) days of the week combined or resistance training, with the exception of individuals with potential problems associated with neuropathy, such as foot trauma and ulcers. Although mean efficacy may be less impressive in real life than that reported in most randomized trials, the true challenge remains to translate current guidelines into durable lifestyle changes.

References
8. Ryan AS, Pratley RE, Goldberg AP, Elahi D: Resistive training increases insulin action in
10. Honkola A, Forsen T, Eriksson J: Resistance training improves the metabolic profile in
RR, Elahi D, Evans WJ: Exercise increases muscle GLUT-4 levels and insulin action in
10. Ishii T, Yamakita T, Sato T, Tanaka S, Fujii S: Resistance training improves insulin
sensitivity in NIDDM subjects without altering maximal oxygen uptake. Diabetes Care
MF: Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with
344:1343–1350, 2001

*******