



Effect of Moderate and High Intensity Exercise on Maximum Oxygen Consumption and Health Related Quality of Life among Type 2 Diabetes Mellitus Participants-Pilot Study

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ABSTRACT

Aim: To determine the effectiveness of moderate and high intensity exercise on maximum oxygen consumption and health related quality of life among type 2 diabetes mellitus participants.

Method: In this study 10 individuals with type 2 diabetes mellitus were selected based on inclusion and exclusion criteria. They are divided into two groups by Odd and Even method. Group A content of 5 participants, received moderate intensity exercise and group B content of 5 participants, received high intensity exercise. Outcomes are maximum oxygen consumption and health related quality of life were taken at the baseline and 4 weeks after the treatment. Both the groups participants continued their medications during study period.

Results: The post-test mean \pm SD value of VO₂max for Group-A is 38.64 \pm 4.18 and for Group-B is 47.98 \pm 5.58 this shows that Group-B is greater than Group A with P value 0.0171 ($p < .05$). The post-test mean \pm SD value of Health Related Quality Of Life for Group A is 9.80 \pm 1.92 and for Group-B is 6.60 \pm 1.14 this shows that Group-B is improved than Group-A.

Conclusions: This study concludes that high intensity exercise is better intervention to improve Maximum Oxygen Consumption (VO₂max) and improve Health Related Quality of Life (HRQoL) in Type 2 diabetes mellitus as compared to moderate intensity exercise.

Key Words: Type 2 diabetes mellitus, Moderate intensity Exercise, High intensity Exercise, VO₂max, HRQoL.

INTRODUCTION

Diabetes mellitus is the one of the major chronic diseases, in that type 2 affect millions of people in the world. It is a metabolic disorder characterized by glucose intolerance. This systemic disease is caused by an imbalance between insulin supply and insulin demand^[1]. 422 million adults were living with diabetes in 2014 globally, compared to 108 million in 1980^[3]. In India, The prevalence of type 2 diabetes mellitus is 2.4% in rural population and 11.6% in urban population^[2]. In Tamil Nadu 1 out of 10 people are diabetic, and every two persons in a group of 25 are in the pre-diabetic stage^[3]. The

development of T2DM is caused by a combination of life-style and genetic factors. While some of these factors such as diet, obesity, increasing age, female gender, and genetics^[4]. β -Cell dysfunction is initially characterized by an impairment in the first phase of insulin secretion during glucose stimulation and may antedate the onset of glucose intolerance in type 2 diabetes^[5]

Regular exercise has many beneficial effects other than improving blood glucose levels as it also improves cardio-respiratory fitness and psychological state of health in diabetic^[6]. **Moderate-intensity** aerobic activity means you're

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working hard enough to raise your heart rate (64%-76% HR-max) and break a sweat. One way to tell is that you'll be able to talk, but not sing the words to your favourite song. **High-intensity** aerobic activity means you're breathing hard and fast, and your heart rate (77%-95% HRmax) has gone up quite a bit. If you're working at this level, you won't be able to say more than a few words without pausing for a breath. [7,8,16]

Individuals with T2DM mellitus are at high risk for both micro and macrovascular complications. Microvascular including retinopathy, nephropathy and neuropathy and Macrovascular such as cardiovascular comorbidities^[9]. Environmental factors like obesity, an unhealthy diet and physical inactivity. The insulin sensitivity can be increased by doing regular exercise and patient can also maintain the blood glucous at normal level^[10]. The regular exercise is always advised to type 2 diabetes mellitus patient, but they fail to do so. By the help of this study we can plan a particular intensity for them and we can reduce the burden and time duration for the type 2 diabetes mellitus patients.

Exercise is integral to the management of type 2 diabetes. Unfortunately, majority of the adults with type 2 diabetes mellitus do not engage in regular exercise. There are evidence that Aerobic exercise have beneficial effects on type 2 diabetes mellitus but there is lack of at what intensity the exercise should be performed ^[11]. So the need for the study is to check the effect of high intensity with moderate intensity exercise on maximum oxygen consumption, health related quality of life among type 2 diabetes mellitus.

METHODOLOGY

10 individuals with type 2 diabetes mellitus were selected based on inclusion and exclusion criteria. They are divided into two groups by Odd and Even method. Group A 5 participants, received moderate intensity exercise and group B 5 participants, received high intensity exercise. Outcome measures are taken at the baseline and 4 weeks after the treatment. Both of the groups are continued their medications during study period.

Study Setting: Saveetha Physiotherapy Clinic, Saveetha Medical College & Hospital, Saveetha University.

Inclusion criteria: Age group - 30 to 40 years, Both male and female were included, Participants not performed any aerobic exercise for last six weeks were included, Participants perform six minute walk test successfully were included, Participants willed to come continuously for 4 weeks.

Exclusion criteria: Uncooperative, Unstable angina, Any cardiovascular disorder, Any neurological disorder, Any musculoskeletal disorder, Any other systemic illness, Obesity (Body Mass Index 30 and above).

Materials used: Cycle ergometer, Two cone, Stopwatch, Inch tap, Digital pulse oximeter.

OUTCOME MEASURES

1. Maximum oxygen consumption (vo₂max)

VO₂ maxis the maximum rate of oxygen consumption as measured during incremental exercise. Maximal oxygen consumption reflects the aerobic, physical fitness of the individual, and is an important determinant of their endurance capacity during prolonged, moderate exercise ^[12]. Unite is ml/min/kg. VO₂max is calculated through 6 minute walk test, using cahalin formula

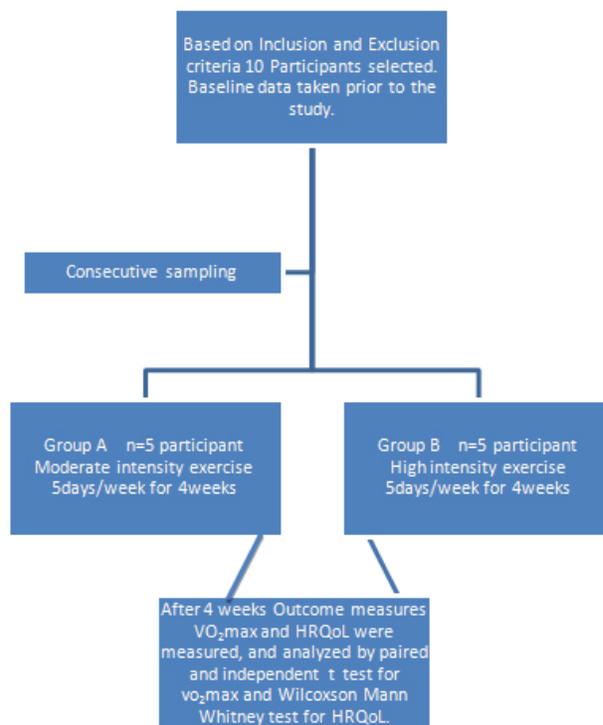
Cahalin formula [VO₂max = 0.006 × 6MWD(feet) + 3.38] (6MWD-six minute walk distance)

2. Health related quality of life

Health-related quality of life (HRQOL) is a multi-dimensional concept that includes domains related to physical, mental, emotional, and social functioning.

EuroQol five dimensions questionnaire (EQ-5D) is a standardized instrument for measuring generic health status^[13]

Flow Chart- 1 Methodology



Treatment Procedure:

Group A (n=5) Moderate intensity exercise

Warm up for 10 minutes(include heel digs, knee lift, shoulder rolls, knee bends, jumping jacks, stretching for calf, quadriceps, hamstring for 15 sec, 3repetition)

Cycling for 20 minutes, maintaining the heart rate percentage between 64% to 76% of maximum heart rate.

Cool down for 10 minutes (included relaxation, marching on spot, stretching for calf, quadriceps, hamstring for 15 sec, 3repetition).

Group B (n=5) High intensity exercise

Warm up-10 minutes(included heel digs, knee lift, shoulder rolls, knee bends, jumping jacks, stretching for calf, quadriceps, hamstring for 15 sec, 3repetition)

Cycling for 20 minutes maintaining the heart rate percentage between 77% to 96% of maximum heart rate.

Cool down for 10 minutes (included relaxation, marching on spot, stretching for calf, quadriceps, hamstring for 15 sec, 3repetition).

Treatment Protocol: (Both A & B Group)

Duration of each session: 40 minute s(Warm up-10minutes, Conditioning period-20minutes, Cool down-10minutes)

Sessions : 1 session/day

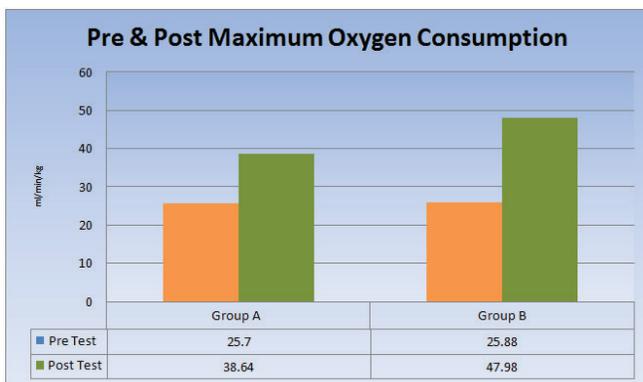
Frequency : 5 days/week

Duration : 4 weeks

Statistical method

The collected data was tabulated and analyzed using descriptive and quartiles statistics. To all parameters mean and standard deviation (SD) was used. Parametric Paired t-test and Independent t test is used for intra and inter group comparison for VO₂max. Non parametric Wilcoxon Mann Whitney test is used for intra and inter group comparison for HRQoL score.

RESULT



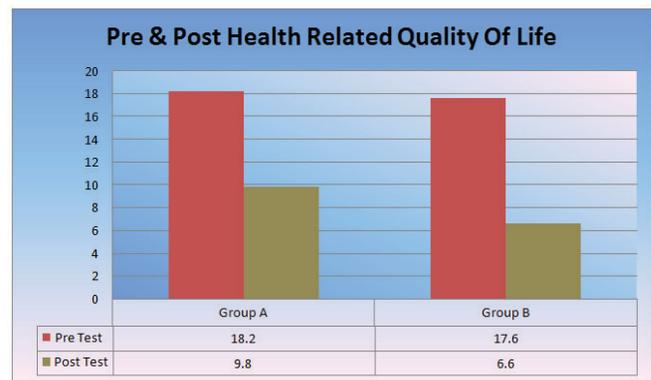
Graph 1: Maximum Oxygen Consumption

The pre-test mean±SD value of Group A Maximum Oxygen

Consumption is 25.7±2.03 and post-test value is 38.64±4.18 this shows that Maximum Oxygen Consumption scores are gradually increased, with P value is 0.004, showing that there is significant difference between pre and post values of Maximum Oxygen Consumption score of Group A.

The pre-test mean ±SD value of Group B VO₂max is 25.88±1.95 and post-test value is 47.98±5.58 this shows that Maximum Oxygen Consumption scores are gradually increased, with P value is 0.001, showing that there is significant difference between pre and post values of Maximum Oxygen Consumption score of Group B.

The post-test mean±SD value of Group-A Maximum Oxygen Consumption is 38.64± 4.18 and for Group-B is 47.98±5.58 this shows that Group-B is greater than Group A with P value 0.0171 (p <.05), showing that there is significant difference between post values of Maximum Oxygen Consumption score of Group A and B.



Graph 2: Health Related Quality Of Life

The pre-test mean ±SD value of Group A Health Related Quality Of Life is 18.2±2.58 and post-test value is 9.8±1.92 this Health Related Quality Of Life scores are gradually decreased, with P value is 0.043, showing that there is significant difference between pre and post values of Health Related Quality Of Life score of Group A.

The pre-test mean ±SD value of Group B Health Related Quality Of Life is 17.6±2.3 and post-test value is 6.6±1.14 this Health Related Quality Of Life scores are gradually , with P value is 0.043, showing that there is significant difference between pre and post values of Health Related Quality Of Life score of Group B.

The post-test mean±SD value of Health Related Quality Of Life in Group A is 9.8±1.92 and for Group-B is 6.6±1.14 this shows that Group-B is improved than Group-A with p value 0.012(p<.05), showing that there is significant difference between post values of Health Related Quality Of Life score of Group A and B.

DISCUSSION

Physical activity play a major role in prevention and management of T2DM, many of DM patient don't remain regularly active. T2DM is a significant cause of premature mortality and morbidity related to cardiovascular disease (CVD), blindness, kidney and nerve disease, and amputation^[14,17].

The goal of treatment in T2DM is to achieve and maintain optimal BG, lipid, and blood pressure levels to prevent or delay chronic complications of diabetes^[15]. Many people with T2DM can achieve BG control by following a nutritious meal plan and exercise program, losing excess weight, implementing necessary self-care behaviours, and taking oral medications, although others may need supplemental insulin^[14].

The purpose of this study was to compare the effect of two exercise intensity (Moderate intensity exercise and High intensity exercise) among type 2 diabetes mellitus patients. The study was detailed and tailored on 10 type 2 diabetes mellitus participants to find the efficacy of which type of exercise intensity was comparatively better among the two groups comprising of 5 participants each group, Group A received Moderate intensity exercise and Group B received High intensity exercise, using two evaluating tools comprising of Maximum Oxygen Consumption ($VO_2\text{max}$) which is calculated based on 6 minute walk distance and Health related Quality of life which is evaluated using EQ-5D questioner.

In this study exercise was given in Cycle ergometer with the participant positioned in sitting position with back supported and foot is connected to the pedals. Before starting exercise warm up is given and after exercise cool down is given. Participants instructed to maintain the heart rate for 64% to 76% of maximum heart rate for Group A (moderate intensity exercise) and 77% to 96% of maximum heart rate for Group B (High intensity exercise).

Intra group comparison for $VO_2\text{max}$ within group A and B was done with parametric paired t test. Inter group comparison for $VO_2\text{max}$ between group A and B was done with parametric independent t test. Intra and inter group comparison for HRQoL score was done with nonparametric Wilcoxon Mann Whitney test. The baseline data are similar in both the group A and B. There was no significant difference between two group. They are equally distributed in age and gender distribution.

The results found in this study disclosed that after four week of treatment, both the groups attained a significant improvement in $VO_2\text{max}$ with $p=0.004$ for group A and $p=0.001$ for group B ($p<0.05$). Moreover both the groups attained a significant improve in HRQoL with $p=0.043$ for group A and $p=0.043$ for group B, compared with the normal confidence interval value of $p<0.05$.

However when inter group comparison is done between two groups the result showed a significant difference with the $p=0.02$ for $VO_2\text{max}$ and $p=0.01$ for HRQoL ($p<0.05$). So the null hypo H_0 is rejected and alternate hypothesis H_1 is accepted, suggesting that High intensity exercise is more effective than Moderate intensity exercise.

The result showed that high intensity exercise is a better strategy to improve maximum oxygen consumption and improve health related quality of life as compared to moderate intensity exercise. However, in the present study, the result of both intervention i.e. moderate intensity exercise and high intensity exercise, individually had a significant effect on improving maximum oxygen consumption and improve health related quality of life.

We only investigated the immediate effect of exercise hence it is not clear how long this improvement will last. Activities of daily living, with exception of exercise training, were not controlled. Further long-term treatment and long term follow up is required.

CONCLUSION

The Statistical analysis made with the quantitative and qualitative data revealed statistically significant difference between the Group A and Group B and also within the group.

This study concludes that high intensity exercise is better intervention to improve Maximum Oxygen Consumption ($VO_2\text{max}$) and improve Health Related Quality of Life (HRQoL) in Type 2 diabetes mellitus as compared to moderate intensity exercise.

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