

## EFFECTS OF SIX MONTH AEROBIC TRAINING ON SELECTED PHYSIOLOGICAL VARIABLES OF MODERATELY ACTIVE FEMALE NIDDM

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### Abstract

The objective of the study was to assess the effects of six month aerobic training on selected physiological and anthropometrical variables of moderately active Indian female NIDDM. Twenty four (N=24) moderately active female NIDDM (Non Insulin Dependent Diabetes Mellitus) aged from 45 to 55 years, were volunteered as subjects for this study. The selected variables considered for the study were Body weight (kg.), Resting Heart Rate (bit/min), Systolic blood pressure (mmHg), Diastolic blood pressure (mmHg),  $VO_2\max$ (ml.kg<sup>-1</sup>min<sup>-1</sup>), Physical Efficiency Index i.e. PEI, Body Mass Index i.e. BMI (kg.m<sup>-2</sup>), Body fat % , Lean Body Mass (kg) and Fat Mass (kg). Cardiorespiratory fitness and Physical Efficiency Index was measured by the Queen's College Step Test and Harvard Step Test respectively. Blood Pressure was measured using standard auscultatory methods and percent body fat was measured by skinfold technique. Aerobic exercises were intervened consisting of Run & walk and Calisthenics for the period of six months (25 weeks). The baseline and post treatment means of respective components were compared by using t-test. Statistical significance was tested either at  $p < 0.05$  levels or at  $p < 0.01$  level of confidence. Result of the study showed that, except Lean Body Mass, aerobic training had significant effect on the maximum aerobic capacity, PEI, RHR, blood pressures (Systolic & Diastolic), body weight, BMI, % body fat, and Fat Mass of the moderately active women with NIDDM. Supervised aerobic exercise training have positive effects on the maximum aerobic capacity, cardiorespiratory endurance, RHR, blood pressures (Systolic & Diastolic), body weight, BMI, % body fat, and Fat Mass of the moderately active women with Non Insulin dependent diabetes Mellitus.

**Keywords:** NIDDM,  $VO_2\max$ , PEI, RHR, Aerobic Training, BMI and Harvard Step Test

### Introduction

The art or mode of human living and the status have already been geared up to an optimum stage i.e. sophisticated mechanized life style.

Such changes in life style, however, obviously resulted in a reduced physical labour and on the other hand increase in mental stress and strain. Ingestion of artificial food components, random use of pesticides and synthetic components in different form and sources in modern life style creates numerous health hazards as well as psycho-physiological disorders in human being. 'Diabetes Mellitus' is one such lifestyle disorder. The term "Diabetes" is derived from two Greek words "Dia" which means "through" and "betes" which means to pass. "Mellitus" is another Greek word which means "sweet". A disease in which the patient passes large quantities of urine containing a sweet substance-Glucose. Diabetes Mellitus is a constitutional disease and not contagious. Diabetes Mellitus is the inability of the body to respond to insulin properly. Diabetes Mellitus is a multi-factorial and multi-system disease. It is a sort of metabolic disorder and is also known as "The Silent Killer". Apart from the heredity, age, sex, body composition, diet and nutrition and stress are the important factors for diabetes mellitus (Gala et al., 2001). The general sign and symptoms of diabetes mellitus are: Frequent Urination, Feeling Hungry, Tiredness, and weight loss that won't heal Sexual dysfunction and Numbness etc. Considering the present situation of the life style disorder i.e. diabetes mellitus in India the present project was planned to initiate research work on moderately active female suffering from Non-Insulin Dependent Diabetes Mellitus (NIDDM) i.e. Type-II Diabetes Mellitus to gather some information about them and to prepare such a training schedule that will help them to cope up from diabetes mellitus.

### Methods & Materials

#### Purpose

The purpose of this study was to assess the effects of six month aerobic training on selected physiological and anthropometrical variables of moderately active Indian female suffering from Non Insulin dependent diabetes Mellitus (NIDDM).

### Subjects

Twenty four (N=24) NIDDM moderately active female ranging between 45 to 55 years, volunteered as subjects for this study. The subject moderately active refers to the housewives who basically engaged themselves to the works of housekeeping. They neither spent their time in sports field nor spent it extremely sedentary. Thus they were termed as moderately active female. The purpose and experimental protocol of the study were critically explained to all the subjects prior to the study and informed consent and assent was received from participants. Ethical approval was received from their family heads. All participants were assured of anonymity and were free to withdraw from the study at any time.

### Variables Studied

The selected variables considered for the study were Body weight (kg.), Resting Heart Rate i.e. RHR (bit/min), Systolic blood pressure (mmHg), Diastolic blood pressure (mmHg),  $VO_2\text{max}$  ( $\text{ml.kg}^{-1}\text{min}^{-1}$ ), Physical Efficiency Index i.e. PEI, Body Mass Index i.e. BMI ( $\text{kg.m}^{-2}$ ), Body fat %, Lean Body Mass (kg)

### Training Protocol

All initial data on selected variables were collected through different standard tests prior to the intervention of the treatment. The subjects underwent a scientifically structured aerobic training for duration of six months which was started in the month of November and lasts up to the end of April. The subjects were participated in the physical training every day except Sunday. They were gone through 12 minutes run and walk as initial treatment load for six days per week. The intensity of Run and walk of each individual was initially set at 65% of the total load taking ability on the basis of the Cooper - Test norms. After 12 weeks, the subjects were given calisthenics exercises, without any interruptions, as aerobic task for 12 minutes (70% intensity) on every alternate day in addition with 12 minutes run and walk (70% intensity). Gradually, after 18 weeks, the duration of calisthenics exercises was increased from 12 minutes to 15 minutes and the distance target was increased from 70% to 75% for 12 minutes Run and walk. The Run and walk was intervened for six days per week and the calisthenics were conducted on alternate days in addition with 12 minute Run and walk. The data on selected variables were collected by two steps i.e. prior to the intervention of the treatment and after the completion of the treatment program.

Table 1  
SIX MONTHS AEROBIC TRAINING PROTOCOL.

Training Period	Nature of Training	Days/Week	Duration	% of max Load
( 1 - 12) week	Run and walk	6 days	12 Minute	65%
(13 - 18) week	Run and walk	6 days	12 Minute	70%
	Calisthenics	3 alternate days	12 Minute	
(19 - 25) week	Run and walk	6 days	12 Minute	75%
	Calisthenics	3 alternate days	12 Minute	

### Statistical Analysis

Mean and standard deviation of each variable were calculated. The pre and post treatment means of respective components were compared by using t-test. Statistical significance was tested either at 0.01 levels or at 0.05 level of confidence. For statistical calculations Excel Spread Sheet of windows version 7 was used.

### Results

The personal data were comprised to age, height and body weight of the subjects. Computed mean and SD were presented in Table 2.

Table - 2  
DESCRIPTIVE STATISTICS (AGE, HEIGHT, AND BODY WEIGHT) OF MODERATELY ACTIVE FEMALE NIDDM SUBJECTS

VARIABLES	MEAN	SD
AGE	51.41	3.67
HEIGHT	154.5	7.09
WEIGHT	PRE	58.53
	POST	55.66

\* At 0.05 level and \*\* 0.01 level of significance, table value 2.20 and 3.10 respectively

Table -2 shows the value of means and SD of Age and Height- 51.41(Kg),  $\pm 3.67$  and 154.5(cm)  $\pm 7.09$  in Pre conditions respectively; and means and standard deviation of Body weight in pre and post test conditions are 58.53kg,  $\pm 4.56$  and 55.66kg, and  $\pm 5.01$  respectively in Moderately Active Female NIDDM.

Table-3  
DIFFERENCE IN MEANS AND SD OF VO<sub>2</sub> MAX, PEI, RHR, BLOOD PRESSURES AND ANTHROPOMETRIC VARIABLES IN PRE AND POST TEST CONDITIONS OF MODERATELY ACTIVE FEMALE NIDDM.

Variable	Pre-Test	Post-Test	MD	t'-Value
	Mean ± SD	Mean ± SD		
VO <sub>2</sub> Max (ml.kg <sup>-1</sup> .min <sup>-1</sup> )	34.33 ± 1.74	36.70 ± 1.44	2.37	5.14**
Physical Efficiency Index	49.30 ± 3.86	54.01 ± 4.27	4.71	5.70**
RHR (Beat/minute)	87.50 ± 7.40	79.33 ± 6.28	8.17	5.80**
BP Systolic (mmHg)	139.66 ± 14.38	127.83 ± 13.99	11.8	5.45**
BP Diastolic (mmHg)	80.00 ± 5.57	72.25 ± 5.46	7.75	8.18**
Body Weight (Kg)	58.53 ± 4.56	54.66 ± 5.01	3.87	2.80*
B.M.I (Kg.m <sup>-2</sup> )	24.52 ± 2.32	22.89 ± 2.63	1.68	2.28*
Body fat %	31.68 ± 3.39	28.21 ± 4.38	3.47	3.07**
Lean Body Mass (kg)	37.80 ± 3.32	39.36 ± 4.03	0.59	0.59
Fat Mass (kg)	18.58 ± 3.64	15.30 ± 4.06	3.24	2.91*

\* At 0.05 level and \*\* 0.01 level of significance, table value of 't' for df (22) 2.20 and 3.10 respectively

Table 3 shows the VO<sub>2</sub>max, PEI, RHR, blood pressure (Systolic & Diastolic), body weight, BMI, % body fat, Lean Body Mass and Fat Mass of moderately active NIDDM women in pre and post tests. In the intervention group, mean of VO<sub>2</sub>max (from 34.33 to 36.70 ml.kg<sup>-1</sup>.min<sup>-1</sup>), mean of PEI (from 49.30 to 54.01) and Lean Body Mass (from 37.80 to 39.36kg) increased, Again the means of RHR (from 87.50 to 79.33), Systolic blood pressure (from 139.66 to 127.83 mmHg), Diastolic blood pressure (from 80.00 to 72.25 mmHg), body weight (from 58.53 to 54.66 kg), BMI (from 24.52 to 22.89 Kg.m<sup>-2</sup>), % body fat (from 31.68 to 28.21) and Fat Mass (from 18.58 to 15.30 kg) decreased after 6 month of aerobic training. There were significant differences between pre and post tests in VO<sub>2</sub>max (t = 5.14, p = 0.01), PEI (t = 5.70, p = 0.01), RHR (t = 5.80, p = 0.01), Systolic blood pressure (t = 5.45, p = 0.01), Diastolic blood pressure (t = 8.18, p = 0.01), body weight (t = 2.80, p = 0.05), BMI (t = 2.28, p = 0.05), % body fat (t = 3.07, p = 0.05) and Fat Mass (t = 2.91, p = 0.05) at post tests. However, there was no significant difference in Lean Body Mass (t = 0.59, p = 0.01) at post tests. Findings showed that exercise training had significant effect on the VO<sub>2</sub>max, PEI, RHR, blood pressure (Systolic & Diastolic), body weight, BMI, % body fat, and Fat Mass in the intervention group (moderately active NIDDM women) after 25 weeks.

## Discussion

The aim of this study was to investigate the effects of exercise training on maximum aerobic capacity, cardiovascular endurance, RHR, blood pressure and anthropometric variables of moderately active women with Non Insulin dependent diabetes Mellitus (NIDDM) or type-II diabetes.

## Maximum Aerobic Capacity and Cardiovascular Endurance

The results of this study showed that the maximum aerobic capacity and cardiovascular endurance of intervention group was increased by 2.37ml.kg<sup>-1</sup>.min<sup>-1</sup> and 4.71 respectively at post tests. Also, it demonstrated that combination of Run & walk and calisthenics (aerobic exercise training) for 25 weeks (six months) had significant effect on the maximal aerobic capacity and cardiovascular endurance of the moderately active women with type-II diabetes. In Sijie T., et al (2012) studied effects of six months of combined aerobic and resistance training and there was 11.5% increase in VO<sub>2</sub>max in elderly patients with a long history of type 2 diabetes after six months. Boule et al., 2003 concluded that regular exercise had a statistically significant effect on VO<sub>2</sub>max in Type 2 diabetic individuals. Mustian et al (2006) reported that combination exercise training can improve aerobic capacity of the women. Schneider et al (2007) reported that mid intensity controlled exercise training maintains or improves the aerobic capacity. The findings of present study confirm the previous studies and shows that exercise training can improve the VO<sub>2</sub>max and cardiovascular endurance in the moderately active women with type-II diabetes. Although the aerobic capacity of women decreases as a result of diabetes Mellitus and its treatments, but exercise training may improve the aerobic capacity. It seems that the improvement in the maximum aerobic capacity as a result of exercise training could cause an improvement in the functional capacity of the moderately active women with Non Insulin dependent diabetes Mellitus (NIDDM) or type-II diabetes. Also, improvement in the maximum aerobic capacity may decrease the signs of exhaustion resulting from the treatment in affected women with NIDDM.

## Resting Heart Rate (RHR)

In this study, RHR of the intervention group was decreased by 8.17beat/min. There was a significant difference in RHR between baseline and post treatment tests, after 25 weeks. Also, this finding shows that the aerobic exercise training can have a significant effect on the decrease of RHR in moderately active women with diabetes Mellitus (type-II). This finding is in agreement with others viz. Pollock et al. 1973 & Lehmann, R. et al. 1995. Therefore, it seems that aerobic exercise training can decrease RHR in the women with type-II diabetes. The mechanism for reduction of RHR can be due to improvement of cardiovascular system as discussed earlier.

### Blood Pressure

In the present study aerobic exercise training have a significant effect on the decrease of blood pressure both for systolic and diastolic of the moderately active women with type-II diabetes. Nevertheless, after 6 months, systolic blood pressure had a 11.83 mmHg decrease and diastolic blood pressure had a 7.75 mmHg decrease in the intervention group. This finding is in agreement with others-Schneider et al. (2007). Therefore, it seems that aerobic exercise training such as ran & walks and calisthenics had better effects on the decrease of blood pressures. Therefore, it seems that aerobic exercise training can improve blood pressure of the moderately active women with diabetes Mellitus (type-II). Also, improvement in the blood pressure may decrease the signs of exhaustion due to the disease in affected women with NIDDM.

### Anthropometric Variables

The findings of this study indicated that aerobic exercise training has significant effects on body weight loss, BMI, Body fat % and Fat Mass of the intervention group. After 25 weeks, body weight, BMI, Body fat % and Fat Mass of the moderately active women having type-2 diabetes decreased by 3.87 kg, 1.68 Kg.m<sup>-2</sup>, 3.47% and 3.24, respectively. On the other hand the training has no significant effect on Lean Body Mass though it increased 0.59 Kg. at post tests. The possible reason for this may perhaps be the loss of fat mass was responsible for relative weight gain of muscle mass (LBM). Thus, the findings of this study showed that aerobic exercise training has a significant effect on body weight loss, BMI, Body fat % and Fat Mass of moderately active women with Non Insulin dependent diabetes Mellitus (NIDDM) or type-II diabetes. Decreased body fat and changed body mass of the subjects suggested that their lean body mass has been increased following training. This would be one of the reasons that led to the improved glycemic control of the exercise group, as skeletal muscle represents the largest mass of insulin-sensitive tissue (Maiorana et al., 2002). Also, it seems that for the effectiveness of the exercise training on body weight, BMI, Body fat % of women with NIDDM, researchers should use supervised aerobic exercise training program.

### **Conclusions**

In conclusion, supervised aerobic exercise training may have positive effects on the maximum aerobic capacity, RHR and anthropometric variables of the moderately active women with Non Insulin dependent diabetes Mellitus (NIDDM) or type-II diabetes. However, aerobic exercise training does not have a significant effect on lean body mass gain of moderately active women with

type-II diabetes.. Therefore, aerobic exercise training has positive effects for the moderately active women with Non Insulin dependent diabetes Mellitus (NIDDM); however, these findings need to be confirmed in future studies.

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