

EFFECT OF HOME BASED GRADED AEROBIC EXERCISE TRAINING ON GLUCOSE HOMEOSTASIS IN OBESE TYPE 2 DIABETES PATIENTS

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ABSTRACT

The research was undertaken on the assigned control groups or experimental group through convenient sampling to collect base line data. Prospective clinical trial was conducted to undertake current study. Overweight and obese individuals from both sexes having type 2 diabetes ranging between age group of 40-60 years were selected as subjects. Further, both the groups were advised to continue with standard diet and medication as prescribed by their respective physicians. Subjects in current study group underwent a supervised orientation to the aerobic walking exercise program including warm-up and cool down. Thereafter, subjects were asked to continue the same at home for a period of three months duration. The duration of exercise was 20 to 25 min per session initially and progressed to 30 - 45 min per session over a period of time with frequency of 4 to 5 times a week, and at intensity of 4 to 5 on Borg's scale RPE (modified). Subjects in the study group were issued with log books to be maintained to ensure the regularity and adherence to the exercise regime. A total of 21 patients in control group and 28 patients in study group completed the study. Results were compared between groups and within group using paired 't'-test and unpaired t'-test. There was significant increase in the blood sugar levels and glycosylated hemoglobin in control group while significant reductions in study group were noted. The home-based graded aerobic exercise improved the glycemic control, in obese type 2 diabetes patients as compared to control group.

Key words: Type 2 diabetes, Obesity, Exercise, Blood glucose levels, Hemoglobin

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INTRODUCTION

Diabetes mellitus is a metabolic disorder occurring due to lack of insulin or a surplus of insulin antagonists leading to a relative lack of insulin. It is characterised by hyperglycemia and glycosuria. The late stage complications like atherosclerosis, diabetic microangiopathy, diabetic nephropathy, diabetic neuropathy, diabetic retinopathy, infections etc. are attributed to the established fact that in insulin resistant states, endothelial nitric oxide synthesis is reduced and insulin mediated vasodilatation gets impaired. Effective management of diabetes comprises of drugs, diet and exercise. Importance of exercise in the management of diabetes has been positively recognised since decades. The possible benefits of exercise for the patient with type 2 diabetes are substantial and recent studies strengthen the importance of long term exercise programs for the treatment and prevention of this common metabolic abnormality and its complications. Aerobic physical activity is a major therapeutic modality for type 2 diabetes. It is well known that regular aerobic exercise produces beneficial effect on glycemic control, insulin sensitivity, lipid abnormalities and hypertension. Slentz CA, Duscha BD, Johnson JL et al (2004) proved that exercises do have a very positive effect on BMI, obesity and body composition. It has been clinically proven that exercises do play a critical role in controlling the glucose level in a diabetic patient. Exercises can be done in a home based setup as well as in a well-equipped institutional setup. Institutional setup is having benefits like supervision by the therapist, close monitoring of the vitals and daily assessment of the progression and specific necessary modifications in the program. But in the Indian context, it has limitations like finance, time, place, and occupational constraints. In contrast to this, though unsupervised, the home based setup overcomes these limitations. On the background of presence of a good literature revealing the effectiveness of supervised endurance and/ or resistance training program for obese type 2 diabetes patients, there is relatively scanty literature focusing on the efficacy of a home based graded brisk walking program on improving lipids and glycemic control in obese type 2 diabetes populations in Indian set up.

MATERIALS AND METHODS

Selection of Subjects:

Patients in this study were initially screened by physician clinically and bio-chemically to confirm the diabetic status. 66 subjects were identified as potential participants for this study. Patients were allotted to the control group or study group through convenient sampling. Baseline data was collected. No change was done in the routine medical treatments that was going and were instructed to report any change done in the medications by the respective physician.

Subjects in the exercise group were given a home based graded brisk walking exercise program for a period of three months. The study group

comprising of 33 patients between age group of 40 to 60 years were bio-chemically confirmed cases of type 2 diabetes. The patients who were willing to perform prescribed exercise were included in this group. The control group comprised of 33 patients between age group of 40 to 60 years were clinically and bio-chemically confirmed cases of type II diabetes and were not willing to participate in the exercise program.

During course of study, 5 patients from control group were excluded from the study as 3 were started on lipid lowering agents by their physicians and 2 patients stopped the exercise regimen within 2 weeks. So total number of 28 subjects $n=28$ (12 males, 16 females) mean age $=50.03 \pm 4.21$ years completed the study duration of 3 months. Out of 33 patients in the control group, 12 patients got excluded from the study due to reasons like starting of lipid lowering agents and insulin. So by the end of the study, Control Group: $n=21$ (13 males, 8 females) mean age $=51 \pm 4.73$ years.

Treatment protocol:

At the beginning of the study, Glycosylated Hemoglobin (GHb), fasting blood sugar (FBS), Post Prandial Blood Sugar (PPBS) and BMI levels were assessed. The Muscular stretch ability and strength in lower limbs were assessed and appropriate physical therapy program was instituted for the study group in case of tightness. The treatment protocol have been presented in table 1.

TABLE 1
TREATMENT PROTOCOL FOR EXERCISE GROUP

Week	Duration	Intensity	Frequency
1 week	20 to 25 min	4-5 (Mod Borg RPE)	4 -5/Week
2 week to 6 weeks	25 to 35 min	4-5(Mod Borg RPE)	4 -5/Week
6 week to 12 weeks	35 to 45 min	4-5 (Mod Borg RPE)	4 -5/Week

Patients in study group were instructed to maintain and to ensure the regularity and adherence to the exercise regime. Patients performed the exercises for a period of 3 months. The investigations were repeated for both the groups at the end of 3 months.

Procedure:

The study protocol was reviewed and approved by the institutional ethical committee of Manipal College of Allied Health Sciences (MCOAHS), Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, India and the health status of all the subjects were reviewed periodically at Advanced Homoeopathy Clinic, AF Stn Jalahalli, Bangalore. Inclusion Criteria: Bio-chemically diagnosed type 2 diabetes patients with BMI of 25 or more and between age group of 40-60 years of both the sexes were selected a subjects and included in the study. Exclusion Criteria: Following category of patients were deemed suitable to be excluded from the current study:

1. Patients already on regular exercise regime.
2. Those pre-diagnosed with cardio respiratory/ musculoskeletal complications which could interfere with exercise program.

3. Those in which exercise might prove harmful by any means
4. Subjects on regular lipid lowering agents, insulin.
5. Subjects with impaired cognition, and patients who could be irregular on doing the exercise i.e., less than three days/ weeks were excluded from the study.

RESULTS AND DISCUSSION

The analysis of data was through SPSS 12. The level of significance was set at 0.05 level of confidence . Paired 't'- test was used to compare the pre and post values of GHb, FBS, PPBS, BMI within exercise group as well as control group. and data pertaining to this have presented in Table 2 to 4. and depicted in Figure 1 to 4.

FIGURE -1

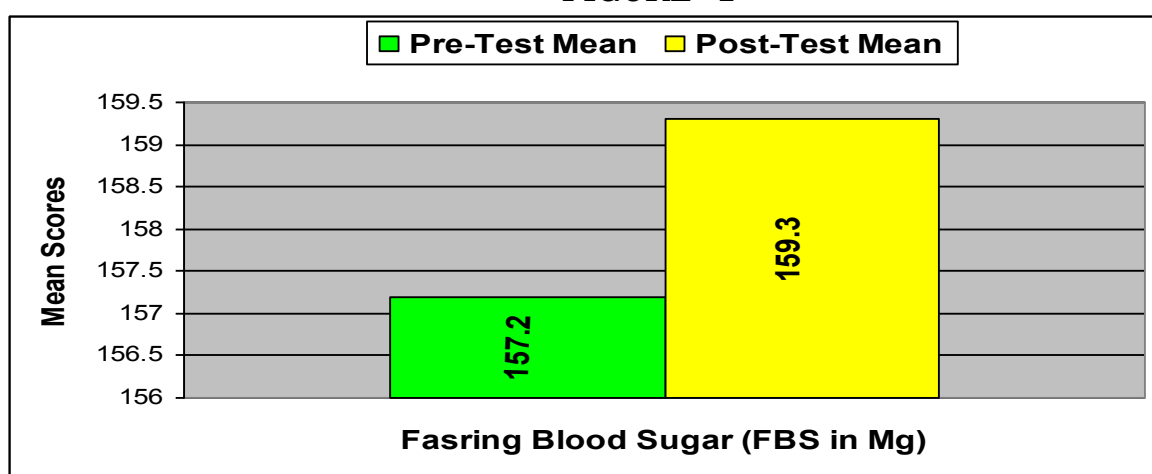


FIGURE -2

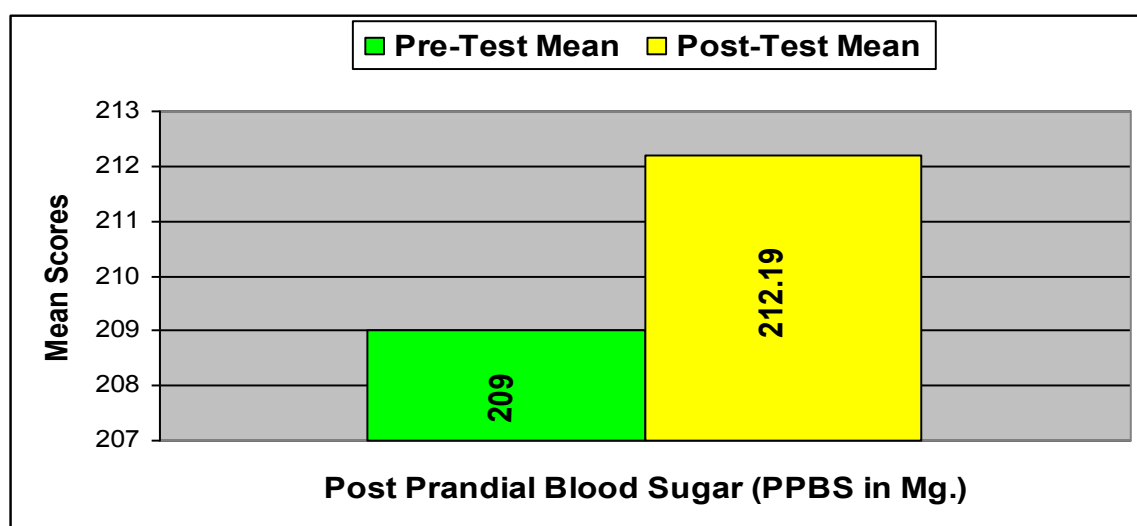


FIGURE -3

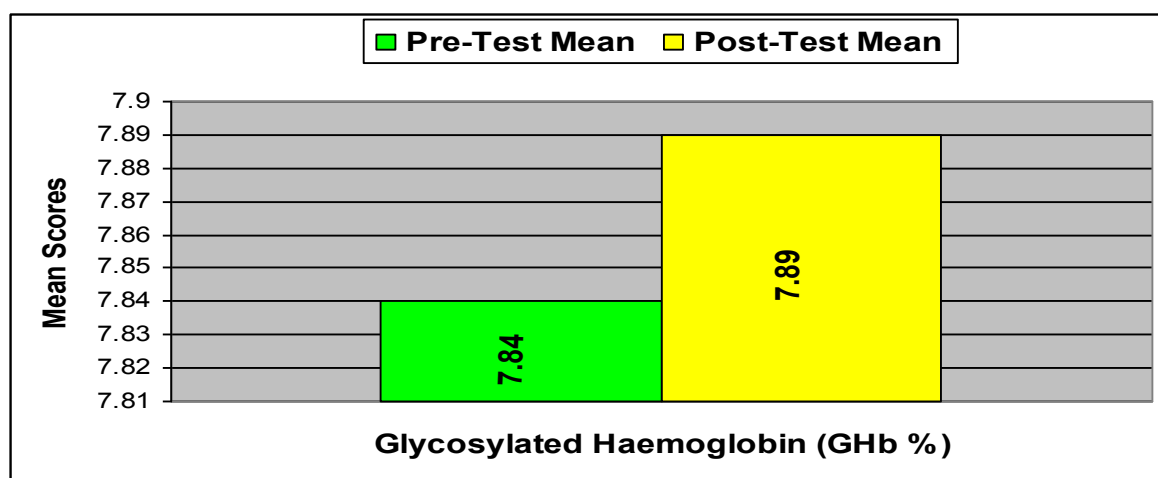


FIGURE -4

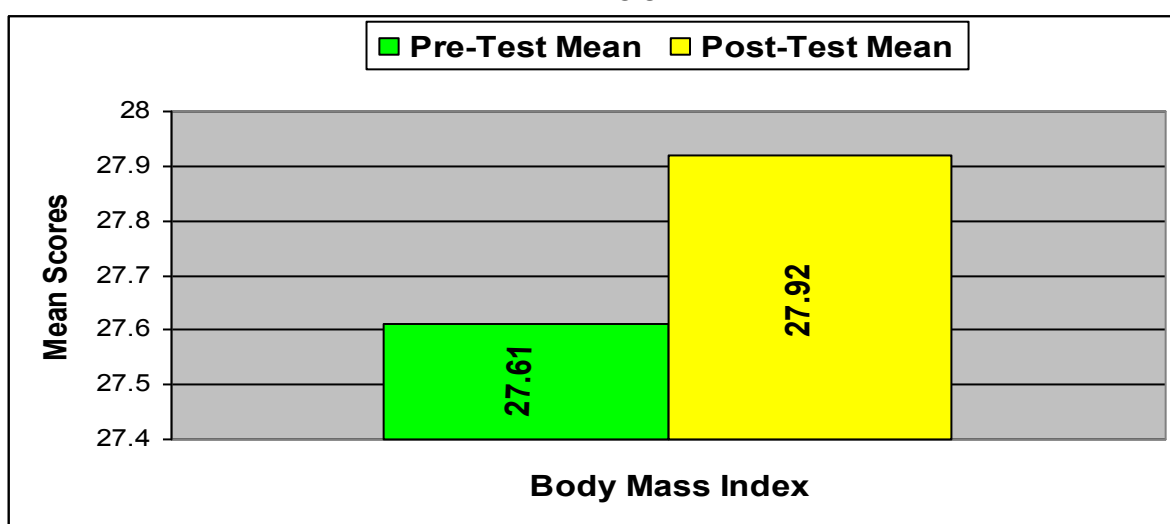


TABLE 2
DESCRIPTIVE STATISTICS OF FBS, PPBS, GHb AND BMI
PARAMETERS OF EXERCISE GROUP AND
CONTROL GROUP (N=28)

Parameters	Control Group		Exercise Group	
	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD
FBS (mg)	157.2 $\pm$ 24.2	159.3 $\pm$ 24.9	181.0 $\pm$ 31.8	172.8 $\pm$ 30.0
PPBS (mg)	209.0 $\pm$ 50.2	212.19 $\pm$ 50.03	233.0 $\pm$ 51.5	226.4 $\pm$ 51.71
GHb (%)	7.84 $\pm$ 1.61	7.89 $\pm$ 1.64	7.86 $\pm$ 0.99	7.37 $\pm$ 1.05
BMI (kg/m ²)	27.61 $\pm$ 1.27	27.92 $\pm$ 1.36	27.64 $\pm$ 1.53	26.87 $\pm$ 1.46

Mean Scores of control and exercise group on pre-test and post test of GHb, FBS, PPBS, BMI of obese type 2 diabetes patients have been depicted in Figure 1 to 4.

TABLE 3
SIGNIFICANCE OF DIFFERENCE BETWEEN PRE-POST TEST MEANS
OF FBS, PPBS, GHb AND BMI OF CONTROL GROUP (N=28)

Parameters	Test Means		MD	σ DM	t- value
	Pre	Post			
FBS (mg)	157.20	159.30	2.10	0.324	6.48*
PPBS (mg)	209.00	212.19	3.19	0.492	6.48*
GHb (%)	7.84	7.89	0.05	0.007	7.14*
BMI (kg/m ²)	27.61	27.92	0.31	0.047	6.59*

* Significant at .05 level

t.05 (54)=2.00

Table 3 indicates that there was statistically significant difference between pre-test and post-test means of FBS, PPBS, GHb and BMI of control group after 3 months, as the obtained t-values of 6.48, 6.48, 7.14 and 6.59 respectively were higher than the required t .05 (54) = 2.00

TABLE 4
SIGNIFICANCE OF DIFFERENCE BETWEEN PRE-POST TEST MEANS
OF FBS, PPBS, GHb AND BMI OF EXERCISE GROUP (N=21)

Parameters	Test Means		MD	σ DM	t- value
	Pre	Post			
FBS (mg)	181.00	172.80	8.20	1.265	6.48*
PPBS (mg)	233.00	226.40	6.60	1.018	6.48*
GHb (%)	7.86	7.37	0.49	0.076	6.44*
BMI (kg/m ²)	27.64	26.87	0.77	0.118	6.53*

* Significant at .05 level

t.05 (40)=2.02

Table 4 indicates that there was statistically significant difference between pre-test and post-test means of FBS, PPBS, GHb and BMI of experimental group after 3 months, as the obtained t-values of 6.48, 6.48, 6.44 and 6.53 respectively were higher than the required t .05 (40) = 2.02

DISCUSSION

This study was carried out in order to explore the effectiveness of graded home based exercise on glycemic control in obese type 2 diabetes. During the study, GHb, PPBS, FBS and BMI values were used as outcome measures. This study focuses that it is beneficial for diabetic population to get involved in regular graded aerobic exercise which need not be in out-patient department (OPD) set up only but even home based brisk walking exercise may lead to beneficial improvements in glycemic control and BMI. It was observed during study that home based walking exercise which was done by study group (n=28) gained benefit in terms of beneficial improvements in glycemic control and BMI. (i.e weight reduction). Whereas, subjects in control group, (n= 21) had deterioration in the same which can be attributed to the sedentary life style.

Mean Sugar levels in the control group were found to be minimally elevated after a period of 3 months from the base line data. They were lacking the brisk walking exercise in contrast to study group. Various biochemical mechanisms can be attributed to this change. Exercise induced changes in Hexokinase (HK) and insulin signaling proteins can be one. Exercise rapidly improves the rate of glucose uptake in the muscle. Modulation of Hexokinase is a first rate limiting and committed step in glucose uptake. There are two HK. They are HK 1 and HK 2 and HK 2 being more specific to insulin sensitive tissues. Insulin and exercise both increase the HK 2 activity and expression.

Exercise improves glucose tolerance by augmenting insulin sensitivity through enhanced receptor affinity and for adequate glycemic control. A significant reduction in insulin resistance is often seen with a long term exercise which is associated with the dynamic changes in the cellular content in the insulin stimulated glucose transporter in the muscle termed Glut 4 receptor. Expression of citrate synthase (a regulator of oxidative phosphorylation) is also seen to be increased as a response to long term aerobic exercises.

Glycosylated Hb (GHb): In the exercise group, GHb was reduced by 0.48% after the intervention when compared with the pre exercise values. This was a significant change. In control group, it remained almost stable in the absence of intervention. A meta-analysis, although the individual trials on the effects of exercise in patients with type 2 diabetes have had partially conflicting results, suggests that exercise training reduces GHb by approximately 0.66%, an amount that would be expected to reduce the risk of diabetic complications significantly.

GHb represents the hemoglobin bound with the sugar in the blood. So higher the sugar level in the blood, higher the percentage of hemoglobin bound to sugars. Reduction in the average sugar levels in the exercise group and improved glycemic control would explain the reduction in the values of GHb.

GHb values provide us a measure of a patient's average glycaemia over the preceding 2–3 months and, thus, assess treatment efficacy. GHb testing should be performed routinely in all patients with diabetes, first to document the degree of glycemic control at initial assessment and then as part of continuing care. Since the GHb values reflects mean glycaemia over the preceding 2–3 months, measurement approximately every 3 months is required to determine whether a patient's metabolic control has been reached and maintained within the target range. Thus, regular performance of the GHb values permits detection of departures from the target in a timely fashion.

The relation between the GHb and sugar levels is well defined in which correlation coefficient is $r=0.82$. So, a drop in the blood sugar level (BSL) in exercise group justify the reduction in the GHb levels also. A significant

reduction in the BMI of the exercise group and in contrast to this was observed. Further, there was an increase in the BMI of the control group after the period of three months. Various mechanisms play a role in the exercise induced lipolysis and loss of fat as expressed in the studies of Paul D, Thompson (2002) and Moro C, et al. (2005).

On the background of the established fact that diet and exercise play an important role in controlling type 2 diabetes, our study focused that these benefits can be acquired even in Indian home based set up. Further, current study needs to be taken up on a larger population and in various states in India. Also, there is a need to study how long the benefits of this intervention would last in case the subjects quit the exercise program.

CONCLUSION

In light of the current study, it is concluded that the graded aerobic exercise improves the glycemic and BMI in obese type 2 diabetes population as compared to control group. The home based exercise program is feasible and is effective in gaining the above effects. Though the current study has been undertaken to study the effect of home based aerobic exercises on the patients of Diabetes Mellitus Type 2 (DM type 2) only, it would be interesting and probably significant to undertake similar studies on the patients of Coronary Artery Disease, Chronic Kidney Disease and Chronic Liver Disease. These studies are ought to be undertaken on a larger samples for obtaining more realistic results.

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