

Effect of Treadmill Exercise on Blood Glucose Control in Type-2 Diabetes Mellitus Patients

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Abstract

Background: Diabetes mellitus type 2 is because of resistance to insulin resulting in inability to utilize glucose. In addition to medicines and diet control, regular exercise helps in increase in utilization of glucose.

Aims & Objectives: To study efficacy of exercise especially treadmill walking on controlling blood glucose homeostasis in diabetes mellitus.

Material and Method: The study was conducted on 40 clinically confirmed cases of type-2 diabetes mellitus male patients who were divided in study group and control group with 20 patients in each group. Study was conducted for period of 8 weeks. Diet plan was formed by expert during this period and subjects were instructed to follow it strictly. Fasting blood glucose and postprandial blood glucose was measured before and after exercise programme.

Findings: There is significant decrease in fasting blood glucose and Postprandial blood glucose level in study group as compared to control group with inter-group difference was significant ($P < 0.05$).

Conclusion: Treadmill exercise is very useful for blood glucose control in addition to diet control and medicines.

Keywords: *Type-2 diabetes mellitus, Treadmill exercise, Fasting blood glucose, Postprandial blood glucose, Glycemic control.*

Introduction

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. The two broad categories of DM are designated type 1 and type 2. Both types of diabetes are preceded by a phase of abnormal glucose homeostasis as the pathogenic processes progress. Type 1 DM is the result of complete or near-total insulin deficiency. Type 2 DM is a heterogeneous group of disorders characterized by variable degrees of insulin resistance, impaired insulin secretion, and increased glucose production.¹

The prevalence of diabetes is going to double globally from 171 million in 2000 to 366 million in 2030 with maximum increase in India. By 2030, around 79.4 million people will be affected by diabetes according to prediction made by Wild et al.²

In addition to medication and diet control, exercise is also helpful in increasing insulin sensitivity. American diabetes association recommends moderate aerobic physical activity of 150 minutes/week.³ Walking is considered to be the best exercise as it involves larger muscles of lower limb as well as muscular work of upper limb. Treadmill machine which is electronically driven or manual simulates all the features of natural walking.

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Material & Method

In our study we used treadmill (Phillips, Novafit turbo) machine, oscilloscope for measuring heart rate and respiratory rate, Sphygmomanometer for measuring

blood pressure, weighing scale. Permission from institutional ethical committee was taken.

From diabetes OPD 40 male patients of age group 45-55 years who were clinically and biochemically confirmed cases of diabetes included in study after obtaining informed consent. Patients with known case of cardiac, respiratory, renal and musculoskeletal disorders were excluded from programme. Those who were willing to do exercise were included in study group and who were not willing to do exercise were included in control group.

Whole programme was conducted for period of 8 weeks. At the beginning of study, fasting blood sugar (FBS) and postprandial blood sugar (PPBS) was measured for all subjects. Additionally weight, height and body mass index was measured. Subjects were examined for any muscular weakness in lower limb. Regular diet may vary in different subjects so diet plan was formed for whole day by advice of dietician and they were explained to follow it strictly during the whole exercise programme so as to avoid effects of diet on blood glucose level.

Treadmill machine (Phillips, Novafit turbo) used for the study can measure speed in form of RPM, total distance travelled in kilometers and calories used during exercise. All subjects in study group were first given demonstration of treadmill machine to make them familiarize. Programme was conducted for total 40 minutes which include 5 minutes of warm up, 30 minutes of treadmill walking followed by 5 minutes of rest. All subjects were instructed to report immediately if they feel breathlessness, headache, dizziness or any other symptoms which are indicative for stopping exercise. Blood pressure, heart rate and respiratory rate were taken in supine at the beginning of exercise.

First warm up was done in the form of active limb movements and muscle stretching. Then oscilloscope was attached for monitoring of heart rate, respiratory rate and blood pressure. Subjects were instructed to walk on treadmill for 30 minutes. Speed of treadmill machine was set to 3.5 km/hour with fixed inclination. All the subjects were constantly monitored for development of any symptoms and any noticeable change in parameters. At the end of thirty minutes, parameters were measured immediately and then they are instructed to take rest for five minutes. Vital parameters were also taken during

recovery period of five minutes. This completed session was conducted for five days in a week for total 8 weeks. At the end of 8 weeks FBS and PPBS was taken again for both groups. Statistical analysis was done using student's t test with p value < 0.05 is considered as statistically significant.

Findings

All the subjects in study group completed exercise programme without any event. Pre and post exercise blood glucose levels are compared in both study and control group.

In study group, FBS and PPBS level before exercise was in the range of 150-196 mg% and 180-212 mg% respectively. After exercise programme range of FBS and PPBS was 130-162 mg% and 156-170 mg% respectively.

In control group, FBS and PPBS level before exercise was in the range of 154-202 mg% and 184-210 mg% respectively. After 8 weeks of observation range of FBS and PPBS was 150-188 mg% and 168-200 mg% respectively.

Difference between FBS and PPBS before and after programme in both the group was compared (Table-1). Mean decrease in FBS in study group was 38.6 mg% while in control group it was 26.8 mg% with intergroup difference is statistically significant ($p < 0.05$). In study group decrease in PPBS was 42.8 mg% as compared to control group having difference of 30.4 mg%. So intergroup difference in PPBS is statistically significant (p value < 0.05). Also subjects in study group reported of feeling of well being with loss of average two kilograms weight.

Table-1 Comparison between study and control group for change in FBS and PPBS after programme

Difference	Study group (mean±SD)
Control group (mean±SD) n=10	
FBS1-FBS2 26 ± 8.910*	38 ± 8.275
PPBS1-PPBS2 30 ± 8.623*	42 ± 6.784
FBS1- Fasting blood glucose before exercise FBS2- Fasting blood glucose after exercise PPBS1- Postprandial blood glucose before exercise PPBS2- Postprandial blood glucose after exercise *p<0.05, student t-test	

Discussion

Diabetes Mellitus is a clinical syndrome comprising a heterogeneous group of metabolic diseases that are characterized by chronic hyperglycemia and disturbances in carbohydrate, fat and protein metabolism secondary to defects in insulin secretion, insulin action or both.⁴ Comprehensive management of diabetes includes drugs, insulin, lifestyle changes comprising of diet control, exercise and education.⁵ In this study, efficacy of treadmill exercise on control of blood glucose was studied in addition to diet control and medication. Exercise improves insulin sensitivity and therefore has a positive effect on blood glucose control. In addition it also has positive effects on lipid profile and blood pressure and it is important part of weight management programme. For inactive person it is better to start with at least 5 minutes daily and then gradually increase 5 minutes to up to at least 30 minutes of daily walking.⁶ Only problem with diet and exercise is that it requires strong motivation and self confidence. So for the patient's perspective oral drugs for diabetes is the best management.

At the beginning of exercise, muscle utilizes stored glycogen as fuel consumption. But it is available only for short period only. If activity is continued, glycogenolysis becomes source of glucose and then after few minutes gluconeogenesis starts in liver. After depletion of glycogen store in liver, stored fat in adipose tissue converted into fatty acids which are used as fuel by muscle.⁷

Wahren et al. reported that working muscles are more sensitive to insulin as compared to resting muscle, which increase utilization of glucose. Also during exercise blood flow to working muscle increase which increase size of capillaries and number of insulin receptors which ultimately balance sensitivity of insulin.⁸

Shivananda nayak et al. reported that after six weeks of treadmill exercise, glucose utilization is increased in muscle which has positive effects on glucose homeostasis with significant fall in fasting and postprandial blood glucose level.⁹

Exercise programme is also affected by some factors like type of exercise, duration of exercise, intensity and frequency of exercise. According to American college of sports medicine, exercise with low intensity but long duration gives better result as compared to high intensity short duration exercise. Duration of exercise should be gradually increased over days. Exercise programme

should be restricted to five days per week. Intensity can be controlled by counting target heart rate with formula of subtracting your age from 220. In this study it was found that endurance exercise helps in control of blood glucose level. It works by increasing insulin sensitivity in exercising muscle. As compared to resting condition, numbers of insulin receptors are more in working muscle which ultimately helps to utilize glucose despite low production by pancreas as in diabetes mellitus.

Conclusion

Well planned exercise programme which is strictly followed can improve glycemic control and also helps to reduce weight. In addition to mental well being it reduces cardiovascular risk factors in patients of diabetes mellitus.

Conflict of Interest: None

Source of Funding: Institution

References

1. Powers AC. Harrison's Principles of Internal Medicine. 18th ed.: 344.
2. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes-estimates for the year 2000 and projections for 2030. *Diabetes care*. 2004;27(3):1047-53.
3. Fauci, Braunwald, Kasper, Hauser, Longo, Jameson et al. Harrison's principles of Internal Medicine. 17th Ed., United States of America, McGraw Hill 2012:2275-2304.
4. Dereje A et al. Diabetes Mellitus, for the ethopian health center team. 2006;11.
5. Krall LP & Beaser RS. *Joslin diabetes manual*. 12th ed. Lea & Febiger, Philadelphia. 1989;81-91.
6. Sherri Shafer RD. Nutrition and exercise intervention for diabetes. Senior clinical dietician UCSF clinical center. 2012;8-9
7. Eberle SG. *Endurance sports nutrition*. 3rd ed. 2014;110-11
8. Wahren J & Felig P. Glucose metabolism during leg exercises. *J clinical investigation*. 1971;(50): 2715-25.
9. Nayak S et al. Influence of aerobic treadmill exercise on blood glucose homeostasis in noninsulin dependent diabetes mellitus patients. *Indian journal of clinical Biochemistry*. 2005;20(1): 47-51