Effect of Physical Exercise Program on Glycosylated Hemoglobin in Type 2 Diabetes Mellitus

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ABSTRACT

The purpose of this study was to clarify the role of physical exercise program on glycosylated hemoglobin with type II diabetes mellitus. Thirty male subjects, participated in this study, they were divided randomly into two equal groups, the first group (treatment) treated by diet therapy plus twelve weeks of physical exercise program, the second group (control) received diet therapy only for 12 weeks, this study was carried out at the Benha teaching hospital, outpatient clinic of internal medicine. Their age ranged from 45 to 55 years. Glycosylated hemoglobin (HbA1c) was measured pre treatment and after twelve weeks. ***Results:*** *The study proved that; physical exercise program had a significant effect on the glycemic control and reduced the average glycosylated hemoglobin (HbA1c) in the treatment group.*

Key words: *Glycosylated hemoglobin, physical exercises, diet therapy and diabetes mellitus.*

INTRODUCTION

Diabetes mellitus describes a metabolic disorder with heterogeneous etiologies which is characterized by chronic hyperglycemia and disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both[15,17].

The long term relatively effects of diabetes include development of retinopathy, nephropathy and neuropathy. People with diabetes are also at increased risk of cardiac, peripheral arterial and cerebrovascular diseases[11].

The symptoms of diabetes often progress to either weight gain or weight loss. If untreated diabetes can have the common complications diabetic ketoacidosis (which can be fatal), diabetic neuropathy (which can cause loss of use of feet and hands), blindness, kidney failure, heart failure, and death[6,8].

The complications of diabetes affect all body systems including the neuromuscular system in the form of sensory, motor and autonomic neuropathies[18]. Motor neuropathy that occurs in diabetes is characterized by muscle atrophy, changes in gait, new pressure points and finally ulceration in foot[13].

Sensory neuropathy is characterized by loss of sensation, bone changes, deformed foot, painless trauma and finally ulceration in the foot[22]. Autonomic neuropathy is characterized by decrease in prespiration, dry skin cracks fissures, infection, moderate sized areas of gangrane and finally amputation[21].

An individual with diabetes may not experience any pain, even with serious vascular disease, because neuropathy can diminish the feeling or perception of these symptoms. Neuropathy is associated with the lack of senses of touch and pain that provide gait protection[12].

Because diabetes is affecting many in the work force, it has a major and deleterious impact on both individual and national productivity[10]. The socio economic consequences of diabetes and its complications could have a seriously negative impact on the economies of developed and developing nations[19].

In type II diabetes mellitus glycemic control is not only by diet nutrition and medicine but also regular exercise has been shown to be effective in glucose control, including: improved glucose tolerance, increased sensitivity to insulin, decreased glycosylated hemoglobin levels, decreased insulin requirements and improved cardio respiratory fitness[9]. HbA1c can be used as a diagnostic test for diabetes[2].

Glycosylated Hemoglobin (HbA1c) of 6.5% is recommended as the cut point for diagnosing diabetes. A value less than 6.5% does not exclude diabetes diagnosed using glucose tests. The expert group concluded that there is currently insufficient evidence to make any formal recommendation on the interpretation of HbA1c levels below 6.5%[7].

Glycated hemoglobin (HbA1c) was initially identified as an "unusual" hemoglobin

in patients with diabetes over 40 years ago. After that discovery, numerous small studies were conducted correlating it to glucose measurements resulting in the idea that HbA1c could be used as an objective measure of glycaemic control[16].

HbA1c was introduced into clinical use in the 1980 and subsequently has become a corner stone of clinical practice[10].

HbA1c reflects average plasma glucose over the previous eight to 12 weeks. It can be performed at any time of the day and does not require any special preparation such as fasting[14].

Diagnosis should be confirmed with a repeat HbA1c test, unless clinical symptoms and plasma glucose levels (200 mg/dl) are present in which case further testing is not required. Levels of HbA1c just below 6.5% may indicate the presence of intermediate hyperglycemia[9].

Persons with a HbA1c level between 6.0 and 6.5% were at particularly high risk and might be considered for diabetes prevention interventions[3].

SUBJECTS AND METHODS

Subjects:

Thirty male subjects participated in this study and divided into two groups, the first group (G1) consisted of fifteen male type II diabetes mellitus DM taking diet therapy plus physical exercise program for 12 weeks, the second group (G2) consists of fifteen male type 2 DM who recieved diet therapy without exercise.

At the start of the program, the patients attended a lecture where the program was explained, including its benefits, risks and recommendations to be followed to assure that physical exercises were performed safely. Physical exercise program was conducted in the morning in room equipped with treadmills and stretching mats.

The treatment session divided as follows: 1) warm-up (5 minutes): stretching exercises; 2) main exercises (30 minutes): walking on the treadmill, and 3) back to relaxation (10 minutes): stretching and relaxation.

At the beginning of the program, intensity of the physical exercise was kept at 60% of the maximum heart rate (max HR) predicted for both groups, and gradually increased until reaching the 70% of max HR target[13].

The two groups were matched in socio-demographic data.

All patients were free from musculoskeletal problems. Their age was between 45 and 55 years.

Equipment and methods:

Glycosylated hemoglobin (HbA1c):

In this study, we used biochemistry Laboratory for recording glycosylated hemoglobin (HbA1c). HbA1c provided the average blood glucose level for the previous three months at each measurement point.

The following levels were considered as indicators of good diabetes control: < 8.0% for school age and < 7.5% for old age. Measurement was carried out two days before starting exercise, and following completion of exercise two days[20].

RESULTS

The socio-demographic data for all patients were measured in the two groups two days before starting our study, as revealed in table (1) and figure (1).

Table (1): Demographic data for both groups.

Variables	Mean ±SD		"t" value	P value	significance
	Treatment group	Control group			
Height (cm.)	178.6 ± 3.21	175.8 ± 3.6	0.6	0.9	NS
Weight (Kg)	80.4 ± 4.6	80.8 ± 3.62	0.44	1.0	NS
Age (year)	55.46 ± 3.2	55.3± 3.5	0.8	0.6	NS

SD: Standard deviation NS: not significant

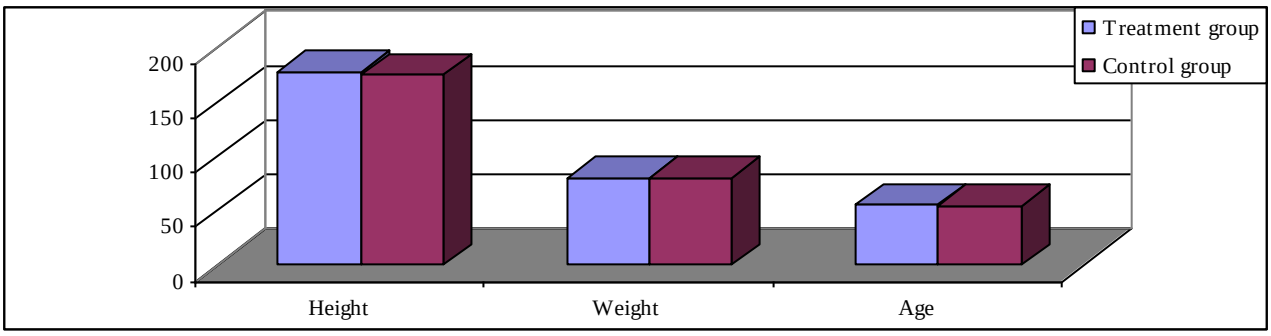

Fig. (1): Demographic data for both groups.

Glycosylated hemoglobin (HbA1c) was measured in the two groups before starting this study as shown in table (2) and figure (2).

Table (2): The mean values of Glycosylated hemoglobin (HbA1c) for both groups 2 days pre treatment.

Variables	treatment group	Control group
Mean	8.1	8.55
± SD	1.87	1.99
"t" value	0.8	
P value	0.6	
significance	Not significant	

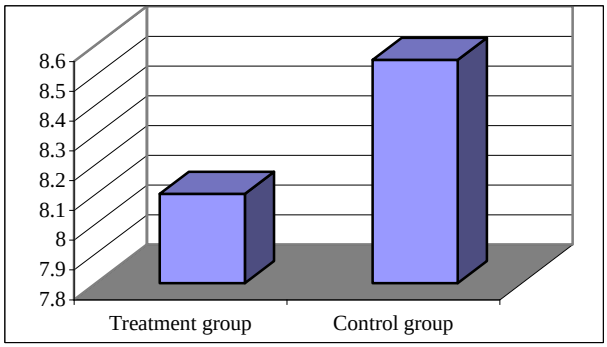

Fig. (2): The mean values of Glycosylated hemoglobin (HbA1c) for both groups 2 days pre treatment.

After 12 weeks of starting this program the Glycosylated hemoglobin (HbA1c) was measured for both groups 2 days post treatment and the gained results revealed a significant improvement in the treatment group (G1) than in the control group (G2), as explained in table (3) and figure (3).

Table (3): The mean values of Glycosylated hemoglobin (HbA1c) for both groups 2 days post treatment.

Variables	Treatment group	Control group
Mean	7.1	8.33
± SD	0.7	1.96
"t" value	5.02	
P value	0.05	
significance	Significant	

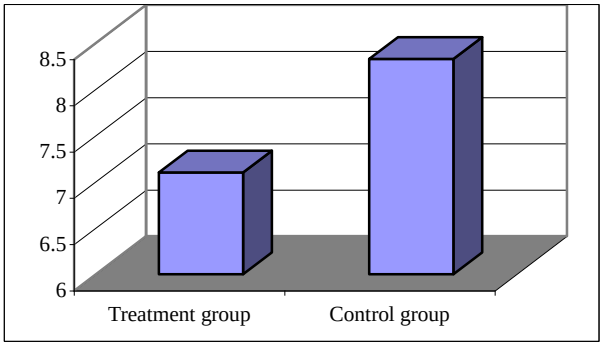

Fig. (3): The mean values of Glycosylated hemoglobin (HbA1c) for both groups 2 days post treatment.

The study proved that, twelve weeks of physical exercise program, had a significant effect on the glycemic control and reducing the level of glycosylated hemoglobin (HbA1c).

DISCUSSION

The prevalence of diabetes mellitus is increasing in all countries all over the world, Both type 1 and type 2 diabetes are associated with increased micro vascular and macro vascular diseases, disability and premature mortality[1,4].

There is strong evidence from randomised controlled trials that better glycaemic control can reduce some diabetic complications. HbA1c can be used as a diagnostic test for diabetes[2].

Fagot et al., 2000[7] reported that there is currently insufficient evidence to make any formal recommendation on the interpretation of HbA1c levels below 6.5%.

Ravid et al., 1996[16] reported that; intensive glucose control substantially reduced onset and delayed progression of micro vascular disease. In type II diabetes mellitus glycemic control not only by diet nutrition and medicine but also regular exercise has been shown to be effective in glucose control, including: improved glucose tolerance, increased sensitivity to insulin, decreased glycosylated hemoglobin levels, and decreased insulin requirements, and improving cardio respiratory fitness[9].

The purpose of this study was to determine the effects of physical exercise program on glycosylated hemoglobin with Type II diabetes mellitus.

This study proved that; twelve weeks of physical exercise program have significant effect on the glycemic control and reducing the average glycosylated hemoglobin (HbA1c).

The results of this study supported by the results of another study done by Cooppan, 1996[5] who explained that; good glycemic control require good diet therapy, insulin injection and aerobic exercise at least for 45 minutes three time every week.

Also the gained results were on line with the work of Nathan et al., 2005[13] who studied the effects of aerobic exercise on glycosylated hemoglobin in adolescents with type 1 DM and proved that good glycemic control require exercise therapy plus medication and diet therapy.

Conclusions:

It could be concluded that; physical exercise program had a significant effect on the glycemic control and reduced the average glycosylated hemoglobin (HbA1c) in subjects who practice exercise than who didn't performing exercise therapy.

REFERENCES

1- Aiello, L.P., Gardner, T.W. and King, G.L.: Diabetic retinopathy. Diabetes Care; 21: 143-156, 1998.

2- Aiello, L.M., Aiello, L.P. and Cavallerano, J.D.: Ocular Complications of Diabetes Mellitus. In Kahn CR, Weir GC, King GL, Jacobson AM, Moses AC, Smith RJ (ed.). Joslin's Diabetes Mellitus. Lippincott, Williams & Wilkins. Philadelphia, PA. 901-924, 2005.

3- Browning, D.J., Glassman, A.R., Aiello, L.P. and Bressler, N.M.: The Diabetic Retinopathy Clinical Research Network Study Group. Optical coherence tomography measurements and analysis methods in optical coherence tomography studies of diabetic macular edema. Ophthalmology;115: 1366-1371, 2008.

4- Chew, E.Y.: A simplified diabetic retinopathy scale. Ophthalmology; 110: 1675-1676, 2003.

5- Cooppan, R.: Implications of the Diabetes Control and Complications Trial. Compr Ther; 22(5): 286-290, 1996.

6- Dellon, A.: Diabetic Neuropathy: Review of a Surgical Approach to Restore Sensation, Relieve Pain, and Prevent Ulceration and Amputation: J foot and ankle International 25, (10): 749-755, 2004.

7- Fagot-Campagna, A., Pettitt, D.J. and Engelgau, M.M.: Type 2 diabetes among North American children and adolescents: An epidemiologic review and a public health perspective. J Pediatr; 136: 664-672, 2000.

8- Glassman, A.R., Beck, R.W., Browning, D.J., Danis, R.P. and Kollman, C.: For the Diabetic Retinopathy Clinical Research Network Study Group. Comparison of optical coherence tomography retinal thickness measurements in diabetic macular edema with and without reading center manual grading from a clinical trials perspective. Invest Ophthalmol Vis Sci.; 50: 560-566, 2009.

9- Holman, R.R., Paul, S.K., Bethel, M.A., Matthews, D.R. and Neil, H.A.: 10-year follow-up of intensive glucose control in type 2 diabetes. N Eng J Med; 359: 1577-1589, 2008.

10- Johnson, J.E., Kennedy, E.J., Sheriff, M.J., Patel, N.C. and Collier, B.D.: Prospective study of bone, indium-labeled white blood cells, gallium-scanning for evaluation of osteomyelitis in the diabetic foot. Foot Ankle Int.17: 10-16, 1996.

11- Martin, C.L., Waberski, B. and Albers, J.: Neuropathy among the diabetes control and complications trial cohort 8 years after trial completion. Diabetes Care; 29: 340-344, 2006.

12- Masi-Benedeti, M.: Changing targets in the treatment of type 2 diabetes. Cur Med Resopin, 22suppl 2: 55-63, 2006.

13- Nathan, D.M., Cleary, P.A. and Backlund, J.Y.C.: Intensive diabetes treatment and

cardiovascular disease in patients with type 1 diabetes. N Eng J Med; 353: 2643-2653, 2005.
14- Nathan, D.M., Kuenen, J. and Borg, R.: Translating the A1C asay into estimated average glucose values. Diabetes Care, 31: 1473-1478, 2008.
15- Nissen, S.E. and Wolski, K.: Effect of Rosiglitazone on the risk of myocardial infarction and death from cardiovascular causes. N Engl J Med; 356: 2457-2471, 2007.
16- Ravid, M., Lang, R., Rachmani, R. and Lishner, M.: Long-term renoprotective effect of angiotensin-converting-enzyme inhibition in non-insulin dependent diabetes mellitus. A 7-year follow-up study. Arch Intern Med; 156: 286-289, 1996.
17- Ray, K.K., Seshasai, S.R.K. and Wijesuriya, S.: Effect of intensive control of glucose on cardiovascular outcomes and death in patients with diabetes mellitus: a meta-analysis of randomised controlled trials. Lancet; 373: 1765-1772, 2009.
18- Schunemann, H.J., Oxman, A.D. and Brozek, J.: Grading quality of evidence and strength of recommendations for diagnostic test and strategies. BMJ., 336: 1106-1110, 2008.
19- Scott, I.U., Bressler, N.M., Bressler, S.B. and Browning, D.J.: Diabetic Retinopathy Clinical Research Network Study Group. Agreement between clinician and reading center grading of diabetic retinopathy severity level at baseline in a phase 2 study of intravitreal bevacizumab for diabetic macular edema. Retina.; 28: 36-40, 2008.
20- Stratton, I.M., Adler, A.I. and Neil, H.A.: Association of glycaemia with macrovascular andmicrovascular complications of type 2 diabetes (UKPDS 35): prospective observational study. BMJ; 321: 405-412, 2000.
21- White, N.H., Sun, W. and Cleary, P.A.: Prolonged effect of intensive therapy in the risk of retinopathy complications in patients with type 1 diabetes mellitus. Arch Ophthalmol; 126: 1707-1715, 2008.
22- Zhang, X., Gregg, E.W. and Cheng, Y.J.: Diabetes mellitus and visual impairment. National Health and Nutrition Examination Survey, 1999-2004. Arch Ophthalmol; 126: 1421-1427, 2008.

الملخص العربي

تأثير برنامج التمرينات العلاجية على معدل الهيموجلوبين السكري التراكمي في الأشخاص المصابين بمرض السكر من النوع الثاني

يهدف البحث إلى دراسة قياس معدل الهيموجلوبين السكري التراكمي في الأشخاص المصابين بمرض السكر من النوع الثاني قبل وبعد أداء برنامج تمرينات علاجية لمدة ثلاثة أشهر (اثني عشر أسبوع) . أجريت الدراسة على ثلاثين شخص في مستشفى بنها التعليمى لمرضى العيادة الخارجية بقسم الباطنة وقسم العلاج الطبيعى وتم تقسيمهم إلى مجموعتين متساويتين تتكون كل مجموعة من خمسة عشر شخصا ذو فئة عمرية من 45 عاما الى 55 عاما . المجموعة الأولى وهم الأشخاص الذين يعانون من مرض السكر من النوع الثاني وملتزمون ببرنامج تغذية علاجية وبرنامج تمرينات علاجية لمدة ثلاثة أشهر (اثني عشر أسبوعا) . المجموعة الثانية : وهم الأشخاص الذين يعانون من مرض السكر من النوع الثاني وملتزمون ببرنامج تغذية علاجية فقط وبدون تمرينات علاجية . تم قياس معدل الهيموجلوبين السكري التراكمي في كلتا المجموعتين قبل بدء البرنامج بيومين ثم تم تطبيق البرنامج العلاجي لمدة ثلاثة أشهر ثم تم إعادة قياس معدل الهيموجلوبين السكري التراكمي مع نهاية البرنامج ومقارنتة قبل وبعد البرنامج . أظهرت النتائج تحسن ذو دلالة إحصائية في انخفاض معدل الهيموجلوبين السكري التراكمي في المجموعة التي طبقت برنامج التمرينات العلاجية لمدة ثلاثة اشهر مقارنة ب المجموعة التي لم تمارس برنامج التمرينات العلاجية .