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Effect of Upper Versus Lower Limbs Resisted Exercise on Nitric Oxide Levels in Diabetic Patients; Type 2

Samir Elgazzar, Omar Elsaadany, Hany Obaya, Mohamed Helmy
Department of Physical Therapy for Cardiovascular, Respiratory Disorders and Geriatrics, Faculty of Physical Therapy, Cairo University
Corresponding author: Mohamed Helmy, **Mobile:** (+20)01008434889, **E-Mail:** helmym0501@gmail.com

ABSTRACT

Background: There were 8.2 million cases of diabetes in Egypt in 2017 with prevalence in adults about 15.1%. As the number of people diagnosed with type 2 diabetes continues to increase it has become imperative that health care providers understand the importance that exercise plays in the treatment of this disease and preventing its complications including nephropathy, retinopathy and cardiovascular disease.

Objective: this study aimed to investigate the effect of upper resisted exercise versus lower resisted exercise on glycosylated hemoglobin and nitric oxide (NO) in diabetic patients type 2.

Methods: this study included 60 diabetic patients who were selected from the outpatient clinic of Internal Medicine Department in Agouza Police Hospital from July 2018 to December 2018. They were assigned into two groups equal in number. Group (A) received a program of upper limbs resisted exercise and Group (B) received a program of lower limbs resisted exercise for 3 months.

Results: The results of this study revealed a significant increase in six-minute walk test and nitric oxide and a significant decrease in glycated hemoglobin in both groups. Group (A) is superior to Group (B) in modulating glycated hemoglobin and nitric oxide levels. Group (B) is superior than Group (A) in increasing six-minute walk test.

Conclusion: upper limbs resisted exercise is beneficial than lower limbs resisted exercise in modulating glycated hemoglobin and nitric oxide in type 2 diabetic patients. Lower limbs resisted exercise is beneficial than upper limbs resisted exercise in improving six-minute walk test.

Keywords: Diabetes type 2, upper limbs resisted exercise, lower limbs resisted exercise, nitric oxide.

INTRODUCTION

Diabetes is a global health problem and the most common chronic disease affecting almost all countries in the world. A pandemic has become widespread and continues to increase at an alarming rate in recent decades[(1)]. Specific long-term effects of diabetes include the development of retinopathy, nephropathy and neuropathy. People with diabetes also have a risk of other diseases, including peripheral cardiovascular disease and vascular brain disease [(2)].

Cumulative evidence suggests that NO is important in regulating glucose uptake during exercise [(3)], especially with people with type 2 diabetes [(4)]. It became increasingly clear that oxidative stress has contributed to the development of large vascular complications [(5)].

In fact, recent studies have shown that the mechanism of ventricular dysfunction is largely due to the bioavailability of NO of endothelial cells derived from oxidative stress [(6)]. Nitric oxide (NO) has an angiogenesis, anti-platelet, anti-proliferative, decreased permeability, and anti-oxidant properties [(7)].

Resistance exercise also showed reductions in the risk of type 2 diabetes in both men and women, regardless of moderate physical activity, with resistance in combination with aerobic exercises that show the greatest benefits [(8)]. Resistance exercise provides other mechanisms to reduce risk factors for CVD compared to aerobic exercise [(9,10)]. Other improvements in involuntary and blanket function have been observed.

Endothelin-1 reduction is important because it is a potent vasodilator and also has atherosclerotic effects, which means that reduction with chronic exercise may have beneficial effects on the cardiovascular system[(12)].

AIM OF WORK

This study aimed to compare between the effect of upper resisted exercise versus lower resisted exercise on glycosylated hemoglobin and nitric oxide in diabetic patients type 2.

PATIENTS AND METHODS

Sixty patients of both genders were selected from outpatient clinic of Internal Medicine Department at Agouza Police Hospital, represented by the sample of this study and all patients were diagnosed as type 2 diabetes (more than 5 years). Their age ranged from (50-60) years and they were on oral hypoglycemic treatment. The study was performed from July 2018 to December 2018. **The study was approved by the Ethics Board of Al-Azhar University.**

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They were randomly divided into two equal groups; Group (A) and Group (B), received a program of resisted exercise for upper and lower limbs respectively. 6 minute walk test, glycated hemoglobin and nitric oxide values were assessed before beginning the exercise program and after 3 months of the exercise program.

Inclusion criteria

- All patients had:

1.Type 2 controlled diabetes (non-insulin dependent).

2. Age ranged from 50-60 years old.

3. Pathological diabetic history of more than 5 years.

4. Body Mass Index from (35 to 39.9).

5. Glycosylated hemoglobin more than 6.5.

6. Early symptoms of numbness and tingling in lower limbs.

7. Under medical supervision with sedentary previous lifestyle.

Exclusion criteria

- All patients had been subjected to full detailed history and full clinical examination for exclusion of the following:

1. Cardiac disease.
2. Chest disease.
3. Hepatic disease.
4. Severe life limiting illness (e.g. cancer).
5. Other endocrinal disorders.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done:

- Independent-samples t-test of significance was used when comparing between two means.
- Chi-square (x^2) test of significance was used in order to compare proportions between two qualitative parameters.
- The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant as the following:
- Probability (P-value)

- P-value <0.05 was considered significant.
- P-value <0.001 was considered as highly significant.
- P-value >0.05 was considered insignificant.
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RESULTS

Patients were randomly divided into 2 equal groups (A and B). For group (A), the mean age, weight and height were (56.07±3.062) years, (102.67±8.121) kg and (167.50±7.371) cm respectively. For group (B), the mean age, weight and height were (55.57±3.51) years, (102.73±8.33) Kg and (167.8±8.002) cm respectively.

Table (1): Comparison between pre-treatment and post-treatment mean value of the variables.

Group (A)	Pre $\overline{X}$ ±SD	Post $\overline{X}$ ±SD	MD	% of change	T-value	p-value	Sig
6MWT	430.33 ± 51.08	445.03± 45.95	14.7	3.42	8.756	0.001	**S**
HbA1c	8.44 ± 1.02	7.57 ± 0.64	0.87	10.31	9.25	0.001	S
NO	6.68±1.31	9.66±1.23	2.98	44.61	20.5	0.001	S
Group (B)	**Pre** $\overline{X}$ **±SD**	**Post** $\overline{X}$ **±SD**	**MD**	**% of change**	**T-value**	**p-value**	**Sig**
6MWT	414 ± 36.03	439.13± 34.48	25.13	6.07	16.23	0.001	**S**
HbA1c	8.92 ± 0.77	8.24 ± 0.68	0.68	7.62	18.56	0.001	S
HbA1c	6.92±1.21	8.41±1.14	1.49	21.53	25.87	0.001	S

$\overline{X}$: Mean, MD : Mean difference, p value: Probability value
SD : Standard deviation, S : Significant
6MWT: six-minute walk test, HbA1c: glycated hemoglobin, NO: nitric oxide

In this study the results found that there was a significant increase in six-minute walk test (3.42%, 6.07 %) and nitric oxide levels (44.61%, 21.53%) in both groups respectively and a significant decrease in glycated hemoglobin in both groups (10.31 %, 7.62 %) respectively in response to resisted exercise.

In relation to glycated hemoglobin and nitric oxide the study revealed that the results obtained in group (A) were superior to that of group (B). In relation to six-minute walk test the study revealed that the results obtained in group (B) were superior to that of group (A).

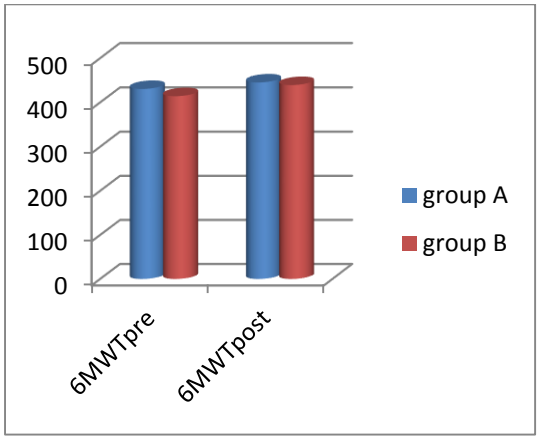

Fig. (1): Mean of six minute walk test pre and post training of groups (A, B)

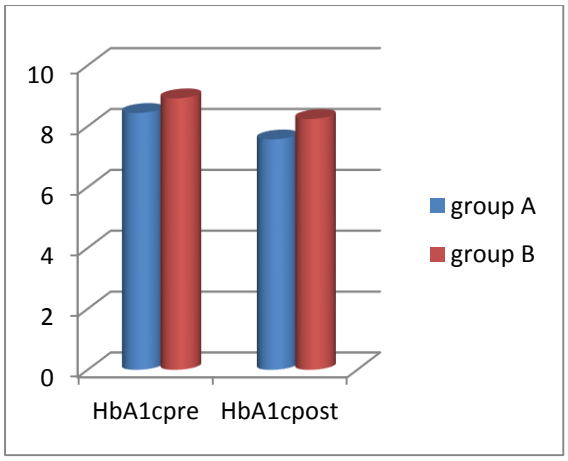

Fig. (2): Mean of HbA1c levels pre and post training of groups (A, B).

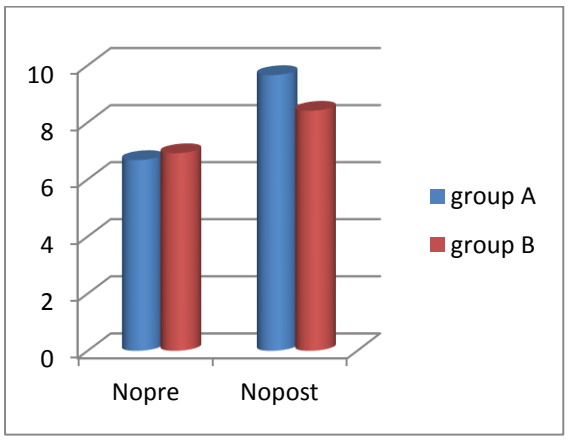

Fig. (3): Mean of NO levels pre and post training of groups (A, B).

DISCUSSION

In this study we found that there was a significant increase in six-minute walk test (3.42%, 6.07 %) in both groups (A and B) respectively.

The results of this study are in agreement with a study done by **Kalapotharakos *et al.*** [13] in which a group of men above 80 years performed 8 weeks resistance training program for lower and upper muscle groups, two times a week, continued to improve muscle strength and 6MWD significantly until the end of the exercise period.

In disagreement with this study, **Reis *et al.*** [14] demonstrated that a 3-month exercise protocol for strengthening lower limb muscles promoted an increase in muscle strength, but not in the distance walked in the 6MWT in a female population with mean age of 53.20±4.4 years.

In this study the results found that there was significant increase in nitric oxide levels (44.61%, 21.53%) in both groups (A and B) respectively. In a previous study to find out the effect of resistance training on old women's plasma nitric oxide levels and blood pressure, there was a significant effect on the increase in plasma concentration of nitric oxide in elderly women and this is an important indicator to prevent cardiovascular disease, especially atherosclerosis and hypertension [15].

Okada *et al.* [16], demonstrated that exercise intervention has beneficial effects on endothelial function in patients with type 2 diabetes.

In this study the results found that there was a significant decrease in glycated hemoglobin in both groups (A and B) (10.31 %, 7.62 %) respectively. According to **Bweir *et al.*** [17]**,** ten weeks of resistance exercises were associated with a significantly better glycemic control in adults with type 2 diabetes compared to treadmill exercise. The resistance training group showed a reduction in the HbA1c values of 18% as compared to an 8% reduction in the treadmill exercise group.

Even an 11% reduction in HbA1c resulted in a 25% reduction in complications associated with the disease.

Baldi and Snowling [18] found that resistance training failed to alter HbA1c levels significantly. However, other studies concluded that glycemic control could be improved with resistance training [19,20,21,22].

In fact, **Ishii *et al.*** [19]**,** showed that the glucose disposal rate was nearly double following the resistance training of 4-6 weeks, but HbA1c levels did not change. Other studies **Dunstan *et al.*** [23] **and Zanuso *et al.*** [24] reported significant declines in HbA1c with resistance training, possibly by improving the storage and utilization of glucose in muscle.

CONCLUSION

The results of this study concluded that upper limbs resisted exercise with moderate intensity (60-75%1RM) is beneficial than lower limbs resisted exercise with moderate intensity (60-75%1RM) in modulating glycated hemoglobin and nitric oxide in type 2 diabetic patients and concluded that lower limbs resisted exercise with moderate intensity (60-75%1RM)) is beneficial than upper limbs resisted exercise with moderate intensity (60-75%1RM) in improving six minute walk test in type 2 diabetic patients.

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