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Effect of Aerobic Exercise on Endurance in Children with Type I Diabetes Mellitus

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ABSTRACT

Background: Decrease in endurance is one of the challenging complications in children with type I diabetes mellitus.**Purpose:**to evaluate the effect of aerobic exercise on the endurance in children with type I diabetes mellitus. **Patients and methods:** Thirty patients with type I diabetes mellitus from both sexes ranged from 8 to 11 years old. They were selected from Police Hospital at Nasr City.They were divided randomly into control& study groups. Both groups were evaluated pre and post treatment by lab analysis for blood glucose level and treadmill to evaluate endurance (distance& time). Treatment time was 40 minutes \ 3 sessions per week \ 3 successive months. Control group received program as muscle strengthening exerciseand same regimen for study group and treadmill as a form of aerobic exercise. **Results;**Children in both groups were showed significant improvement in all measured variable post treatment (p<0, 05). The significant improvement was in the favor of study group as compared to control group.**Conclusion:** aerobic exercise may be added as a part of treatment program in improving the endurance of children with type I diabetes mellitus.

Key words: diabetesmellitus- aerobic exercise -endurance.

Introduction

Diabetes mellitus is a group of chronic metabolic disorders which is recognized by increased blood glucose due to reduced insulin secretion or reduced insulin action[1].Type I diabetes mellitus (T1DM) is a chronic illness characterized by the body's inability to produce insulin due to the auto immune destruction of beta cells in the pancreas [2].It usually starts in children aged 4 years alder with the peak incidence of onset at age 11-13 years [3].Complications of T1DM are classifiedinto acute and chronic complications. The Severity of complications is ranged   from mild symptoms (hunger, shakiness, irritability, sweating) to seizures, loss of consciousness, coma, and death[3].Weight gain may become a problem in patients who eat greater amounts in an attempt to compensate for insulin excess and avoid hypoglycemia and fatigue and poor balance[4].

Aerobic exercise is aconstant moderate intensity work that uses up oxygen at a rate in which the cardiorespiratory system can use oxygen in the working muscles. Examples of such activity are stationary bike riding or walkingontreadmill[5].

Precautions to exercise for children with diabetes mellitus include 1-stylolic blood pressure (SBP) should not rise above 180mm/hg;2-Avoid weight lifting, breath holding or high intensity aerobic exercise;3-avoid head positioning below the waist;4-SBP should not rise above 20-30 mm/hg above resting blood pressure (RBP);5-monitor for signs and symptoms of silent ischemia (dyspnea, diaphoresis,

orthostatic hypotension);6- fluid ingestion should take before and during and after exercise;7 -proper foot wear,;8- exercise should be avoided prior to going to bed and rotate insulin injection sites away from active muscles.[6]

Endurance is the ability of body to continue fitness activities for long period of time. Endurance exercises like muscle strengthen exercise, walking [7].

The aim of this studywas to study the effect of aerobic exercise on endurance in children with type (I) diabetes mellitus.

Subjects, Materials and Methods:

The clinical study was approved from the ethical committee of Faculty of physical therapy, Cairo University as well as written consent from children's parents or legal guardians were obtained before starting the study. The study was conducted at outpatients' clinic in Police Hospital at Nasr City. The study started in January2016 and ended in December 2016.

Subjects;

Thirty patients with T1DM participated in this study, the chronic of disease ranges between 3 to 5 years. They received long acting insulin and diet control.The participated patients were from both sexes and their ages ranged from8 to 11 years and their height should not less than 1 meter. The patientswith other hormonal diseases,hereditary sensory and autonomic neuropathy and orthopedics problem were excluded from this study.They were selected from outpatient's clinic of physical therapy in Police Hospital at Nasr City. They were randomly assigned into two groups (Control&study) 15 children in each. Randomization process was

performed through the Statistical Package for Social Science (SPSS) (version 20) for windows.

Methods;

1- for evaluation;

Both groups were evaluated by 1- Weight and height scales were used to measure children weight and height then body mass index (BMI) was calculated according to the following equation ; weight (Kg)/height(m)^2, 2- Lab analysis for blood glucose (fasting blood glucose&post prandial blood glucose) and 3-Treadmill endurance test to evaluateendurance by evaluation distance and time. All evaluated parameters were done pre and post 3 successivemonths of treatment except the height, weight and BMI of the patients.

2- for treatment;

Both groups received strengthen exercises program for 40 minutes including;

1- Warm up exercises consisting of stretching exercises for the major muscles groups and active exercises for the whole body and breathing exercises for 5 minutes.

2- Resistance strengthening exercises for the whole body as the following;

Hip, knee and ankle flexion and extension; Hip and knee adduction and abduction; Ankle dorsi and planter flexion; Shoulder and elbow flexion and extension; Shoulder and elbow adduction and abduction; Breathing exercises and

Back and abdominal exercises then the repetitions were performed for all 2 sets. Each set contain 10 repetitions. The subjects completed each exercise in controlled rhythm with a rest periods of 2 minutes between sets and the time required to complete resistance exercises was 30 minutes.

3- Cooling down in the form of stretching exercises for the large muscles groups to return to normal state for 5 minutes. [8]

While the study group received; Received the same regimen in addition to walking on treadmill for 15 minutes with zero inclination and speed 1.5Km/h and intensity 70% of maximum heart rate [8] according to **Michal (2006)** [9]; target heart rate (THR) was 70% of maximal heart rate (220- age). THR was calculated to determine the exercise intensity for each individual. They received the same. Participants were asked to report their level of exertion during the peak performance of the exercise [8]. During the session the physical therapist should take care of the glycemic response to exercise can be summarized as follows according to American Diabetes Association 2001 [10];

-Avoid exercise if fasting blood glucose levels are>250 mg/dl and ketosis is present, and use caution if glucose levels are >300 mg/dl and no ketosis is present.

- Blood glucose monitoring before and after exercise.

- consume added carbohydrate as needed to avoid hypoglycemia.

- Carbohydrate –based foods should be available during and after exercise.

Statistical analysis

All statistical measures were performed through the Statistical Package for Social Science (SPSS) version 20 for windows. As a prerequisite for parametric assumption, data was screened for normality. Normality assumption was assessed using the tests of normality in addition to assessing for the presence of extreme scores, and skewness and kurtosis. Descriptive analysis using histograms with the normal distribution curve showed that the data were normally distributed and not violates the parametric assumption for each distance, time, fasting blood glucose, and 2h post prandial. All these findings allowed the researchers to conduct parametric analysis. So, "paired t test" was used to compare between "pre" and "post" tests for each dependent variables for each group. "Unpaired t test" was conducted to compare dependent variables between both groups with the alpha level 0.05.

RESULTS

There were no statistically significant differences (P>0.05) between subjects in both groups concerning age, weight, height, and BMI (Table 1).the study group was 15 patients there was 3 patients dropped and the control was 15 patients and 1 dropped *the patients not regular participated in the treatment program.

Table (1): Demographic and baseline clinical characteristics of children in both groups:

Characteristics	Study group (n =12)	Control group (n =14)	t-value	P-value
Age (years)	9.26 ± 1.03	9.53± 1.12	-0.676	0.505
Weight (kg)	33.13± 2.92	34.06± 5.09	-0.616	0.543

Height (cm)	137.7± 14.46	142.6± 8.2	-1.972	0.06
BMI (kg/m2)	18.49 ± 4.05	16.77± 2.27	1.43	0.164

Values of age, weight, height, and BMI are expressed as mean (SD).

There was non-significant difference (P> 0.05) between subjects in groups pretreatment in all elevated parameters Distance, time, fasting blood glucose, and 2h post prandial.

There was a significant increase of distance and time (p<0.05) for both groups. As well, there was a significant reduction of fasting blood glucose and 2h post prandial (p<0.05) for both groups. as shown in table (2 and 3). Comparing the all evaluated parameters between both groups post treatment as shown in table *4(there was significant increase in distance and time in favor of study group and significant reduction in fasting blood glucose and 2h post prandial in favor of study group. Table (4) presentdescriptive statistics between group comparison and percent of improvement of all detective variables at both groups.

Table (2): Mean values variables pre and post treatment in study group.

Parameters	Study group (n=12)		p-value
	Pretreatment Mean ± SD	Post treatment Mean ± SD	
Distance (cm)	148.13 ± 45.57	408.66 9± 3.87	0.0001*
Time (min)	3.98 ± 1.29	9.92± 2.75)	0.0001*
Fasting blood glucose	161.13 ± 12.82	125.86 ± 12.92	0.0001*
2h post prandial	193.73 ± 12.69	153.86± 12.89	0.0001*

*Significant level is set at alpha level <0.05.

Table (3): Mean values pre and post treatment in study groupcontrol group.

Parameters	Control group (n=14)

	Pretreatment Mean ± SD	Post treatment Mean± SD	*p*-value
Distance (cm)	143.26 ± 69.40	211.33 ± 84.67	0.0001*
Time (min)	3.2 ± 1.39	3.66 ± 1.48	0.0001*
Fasting blood glucose	155.33 ± 9.71	135.73± 10.15	0.0001*
2h post prandial	187.66 ± 11.43	165.66± 10.18	0.0001*

*Significant level is set at alpha level <0.05.

Table (4): Mean values, and percent of improvement of all dependent variables post treatment at both groups.

Parameters	Post treatment		% of improvement		p\value
	Study group	Control group	Study group	Control group	
Distance (cm)	408.66 ± 93.87	211.33 ± 84.67	175.8%	47.5%	0.0001*
Time (min)	9.92 ± 2.75	3.66 ±1.48	149.24%	14.06%	0.0001*
Fasting blood glucose	125.86 ± 12.92	135.73 ±10.15	21.88%	12.61%	0.028*
2hpostprandial	153.86 ± 12.89	165.66 ±10.18	20.57%	11.72%	0.0001*

*Significant level is set at alpha level <0.05.

Discussion

The present study was conducted to evaluate the effect of aerobic exercise on the endurance of children with type 1 diabetes mellitus.

Physical activity has multiple health benefits, like blood pressure reduction, improvement of cardiovascular fitness, lipoprotein profileand the positive effects on glycemic metabolism [11].

Thirty diabetic children participated in this study they divided into two groups of equal numbers, both groups were received resisted muscles strengthen exercises in addition to walking on treadmill for study group.

There was significant improvement in all elevated parameters in both groups as shown in table 4. There wassignificant reductionin fasting blood glucose, post prandial blood glucose and significant increasein time and distance for both groups.But the significant reduction in blood glucose and post prandial blood glucose was in favor of the study group while the significant increase in time and distance was in favor of the study group.

The percentage of reduction in fasting blood glucose was21.88% and for post prandial blood glucose was20.57%for study group compared to control group.These results were matched with pervious study conducted by **Cristian,et al[12]**as a literature search to discuss the practical aspects of safe physical activity and sports participation in children and adolescents with type I diabetes mellitus. They concluded that skeletal muscle glucose uptake is greater during aerobic metabolism in order to generate energy for muscle contraction, which suppresses hepatic gluconeogenesis and thus promotes a decrease in blood glucose levels.

On the other side, the results of this study concerning FBG andPPBG were contradicted with the study of **RoselineD.hoogeet.,al**[13]who designed a double-blind randomized controlled trial on sixteen children with type I diabetes mellitus receiving combined aerobic and strengthen exercise or no training. The training was twice a week for 20 weeks in the combined aerobic and strengthening group. They found no significant difference concerning FBG and PPBG between the two groups. These controversial results might be because of the different methodological approaches or different number of studies groups.

There wassignificant increase in distance and time for study group as the percentage of improvement was 175.8% for distance and 149.57% for time compared to control group, these results were in accordance with**Treat D. Jacobson et.,al.**[14]who compared walking on treadmill and bicycle ergometer in diabetic patients.They found that distance improved in walking on treadmill as there was improvement in muscle metabolism in both lower limbs and improvement of circulation of the whole body.

The results of this study disagree with**Tracie C.Collins et.,al**[15] who stated that walking on treadmill did not improve walking distance but improves walking speed and quality of life in people with diabetes as they conducted the trial within 145 diabetic patients .

The significant improvement in distance and time in this study wassupported by **Szymczack M.et.,al**[16] who stated that improvement in time and distance of walking on treadmill for diabetic patients are as a result of increase in circulation in lower limbs, improved aerobic metabolism and increase in muscles fibers of lower limbs.

Conclusion

Aerobic exercise may be added as a part of treatment program in improving the endurance of children with type I diabetes mellitus.

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الملخص العربى

عنوان البحث :

تاثير التمرينات الهوائية على قوة تحمل لدى الاطفال مرضى النوع الاول من البول السكرى.

الهدف من البحث:

الهدف من الرسالة دراسة تاثير التمرينات الهوائية على قوة التحمل لدى الاطفال مرضى النوع
(1)من السكر حيث ان النوع (1) من البول السكرى له تاثيرات و مضاعفات كثيرة على الأطفال.

مواد البحث و اساليبه:

تم اجراء البحث على ثلاثين مريضا من الأطفال المصابين بالنوع (1) من البول السكرى حيث مدة
المرض عندهم تترواح من 3 الى 5 سنوات و يخضعون للعلاج بنفس نوع الانسولين و نفس النظام الغذائى.
و قد تم استبعاد الأطفال الذين يعانون من مشاكل سمنة و امراض بالجهاز العصبى او الجهاز العضلى او اى
امراض اخرى تتداخل مع البحث. وقد تراوحت اعمارهم من 8 سنوات الى 11 سنة حيث تم اختيارهم من
عيادة العلاج الطبيعى بمستشفى الشرطة بمدينة نصر .

مدة العلاج 40 دقيقه لمده 3 جلسات اسبوعيا لمدة3 شهور متتالية.

وقد تم تقسيم الأطفال الى مجموعتين:

1-مجموعة ضابطة:تحتوى هذه المجموعه على 15 طفلا وقد تلقت هذه المجموعة مجموعة من التمرينات
فى صورة تقوية لجميع عضلات الجسم.

2- مجموعة الدراسة: تحتوى هذه المجموعة على 15 طفلا و قد تلقت هذه المجموعة المشئ على الماشية
الكهربائية بالاضافة الى تمرينات التقوية لجميع عضلات الجسم التى تلقتها المجموعة الضابطة .

و قد تم قياس الاتى قبل و بعد ثلاث شهور من العلاج:

1 - قياس نسبة السكر فالدم الصائم و الفاطر

2 ـ قياس قوة تحمل الأطفال بواسطة الماشيه الكهربائيه لقياس الوقت و المسافة التى يقطعها الطفل حتى يشعر بالتعب او ظهور علامة من علامات هبوط فى مستوى السكر فى الدم.

النتائج :

و قد أظهرت النتائج وجود فروق ذات دلالة احصائية فى جميع المتغيرات المقاسة بالنسبة للمجموعتين و لكن كانت نسبة التحسن فى مجموعة الدراسة اكثر من التحسن فى المجموعة الضابطة.

الخلاصه:

و قد أظهرت النتائج أن المشى على الماشية الكهربائية مع اجراء تمارينات التقوية لكل عضلاتالجسم لهم تأثير ايجابى على قوة تحمل لدى الطفل مريض النوع الاول من البول السكرى .