Keywords: Parkinsonian patients, Sensory integration and Stereotactic Aerobic

Versus Resisted Exercises on Glycemic Level in Juvenile

Diabetes Mellitus

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Abstract

Background: Juvenile diabetes mellitus is an autoimmune disease caused by the immune-mediated destruction of pancreatic beta cells. This destruction is modulated by the body's immune system and leads to a limitation in, or complete cessation of, the production and secretion of insulin, which results in the need for external insulin delivery for survival**. Aim:** The current study intended to compare the effect of aerobic exercise and resisted exercise on glycemic level in children with type 1 diabetes mellitus.**Subjects and methods:** Thirty children of both sexes with type 1 Diabetes Mellitus. Their ages ranged between 11 and 15 years, they participated for twelve weeks, three sessions per week.They were allocated randomly into two groups of equal numbers, group (A) and group (B). Children in group(A)received regular aerobic exercise three days/week for three successive months. Those in the group (B) received a resisted exercise three days/week for three successive months. **Results:** Pre and post treatment comparisons showed a statistically significant improvement of the measured variables in group (A).Moreover, significant difference was recorded in the group (A). **Conclusion:** Designed aerobic and resisted exercises contributed to the improvement of blood glucose level in children with type 1diabetes mellitus in favor to group (A) Aerobic exercise is more effective in improving blood glucose level than resisted exercise.

Keywords: Aerobic exercise, resisted exercise, glycemic level, Juvenile diabetes mellitus.

Introduction

Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder caused by an absolute or relative deficiency of insulin, an anabolic hormone. Insulin is produce by the beta cells of the islets of Langerhans located in the pancreas, and the absence, destruction, or other loss of the cells results in type 1 diabetes (insulin-dependent diabetes mellitus IDDM). Most children with diabetes have type 1 diabetes mellitus (T1DM) **(16).**

Type 1 diabetes is (T1DM) known as insulin dependent diabetes mellitus or juvenile onset diabetes is a chronic illness characterized by the body's inability to produce insulin due to the autoimmune destruction of the beta cells in the pancreas. Most pediatric patients with diabetes have type 1 and a lifetime dependence on exogenous insulin **(13).**

Exercise has many positive health and psychological benefits including physical fitness, weight management, and enhanced insulin sensitivity. It also provides opportunities for social interactions and builds self-esteem. However, exercise creates challenges for people with type 1 diabetes due to the increased risk for both hypoglycemia and hyperglycemia. During exercise, multiple hormones (insulin, glucagon, catechol amines, growth hormone, and cortisol) control fuel metabolism and create a balance between glucose uptake by exercising muscles and hepatic glucose production. The equilibrium between insulin secretion and the counter regulatory hormones varies according to the exercise type, intensity and duration **(10).**

Aerobic exercise is physical activity, such as walking, bicycling or jogging, that involves continuous, rhythmic movements of large muscle groups lasting for at least 10 minutes at a time**(4).**

Aerobic exercise is any physical activity that uses large muscle groups and causes the body to use more oxygen than it would while resting. The goal of aerobic exercise is to increase cardiovascular endurance. Examples of aerobic exercise include running, cycling, brisk walking, skipping rope, rowing, hiking, playing tennis, continuous training, and long slow distance training **(9).**

Aerobic exercise is a physical exercise of low to high intensity that depends primarily on the aerobic energy generation process. Aerobic

mean the use of oxygen it refers to the use of oxygen to meet energy demands during exercise via aerobic metabolism. Generally light to moderate intensity activities that are sufficiently supported by aerobic metabolism can be performed for extended period of time. Aerobic exercises are those like running, jogging, swimming, cycling and walking **(5).**

Aerobic exercise is physical activity, such as walking, bicycling or jogging, and swimming) involves repeated and continuous movement of large muscle groups that rely primarily on aerobic energy-producing systems **(3).**

Resistance exercise is physical activity involving brief repetitive exercises with weights, weight machines, resistance bands or one's own body weight (e.g. pushups) to increase muscle strength and/or endurance **(2).**

Resistance exercise is a physical activity involving brief repetitive exercises with weights, weight machines, resistance bands or one's own body weight (e.g. pushups) to increase muscle strength and/or endurance **(21).**

Resistance training improves glycemic control (as reflected by reduced glycated hemoglobin (A1C), decreases insulin resistance and increases muscular strength in adults with type 2 diabetes **(11).**

Additionally, resistance training has been shown to increase lean muscle mass and bone mineral density, leading to enhanced functional status and prevention loss of muscle tissues and osteoporosis **(1).**

Subject, materials and methods

An experimental study was conducted from November 2017 to February 2018 in Hurghada General Hospital.

Ethical consideration:

Ethical committee approval of the Faculty of Physical Therapy, Cairo University, Egypt as well as a signed written consent form with parent acceptance for participation in the study and publication of the results were obtained before starting the study procedure.

Subjects:

This is an experimental study in which thirty volunteer children from both genders with type 1 diabetes mellitus participated in this study. The sample selection, assessment and treatment procedures were conducted at Hurghada general hospital.

Inclusion criteria:

1. Both genders were included.
2. Their ages ranged between 11-15 years old.
3. They were controlled by the same insulin therapy.
4. The chronicity of disease ranged between 3 to 5 years.
5. Body mass index range (5th percentile to less than 95th percentile) (normal weight according to CDC chart.

Exclusion criteria:

Subjects were excluded if they had any of the following criteria:

1. Hereditary sensory and autonomic neuropathy.
2. Cardiac, neurological, orthopedics problems and any other disease may affect the research e.g. chest disease.
3. Any subject out through the study more than three sessions was excluded.

Group (A):

Children in this group (11 boys and 4 girls) received the aerobic exercise. This program was conducted three times /week for three successive months.

Group (B):

Children in this group (11 boys and 4 girls) received the resisted exercise. This program was conducted three times /week for three successive months.

Instruments

Instruments for evaluation

1. **Recording data sheet:** All information of each patient participated in this study was recorded in a recording sheet.
2. **Two hours glucose tolerance curve:** Was used to measure blood glucose level.
3. **Height and weight scale:** A universal height and weight scale was used to determine the subjects weight and height in order to calculate the body mass index (BMI) for each subject in both group (A&B) according to the following equation: BMI = weight (Kg)/height (m) 2.

Instruments for treatment

- **Group (A):** Aerobic exercise is made by using a treadmill, which is a device for walking or running or climbing while staying in the same place. Techno gym treadmill which it consists of treadmill with an instrumented deck that monitors and records patient data. It monitors the time that the patient can take in the gait cycle, the distance, the speed and the heart rate.
- **Group (B):**Resisted exercise is made by using a sandbag which is one of the most simple and yet the most effective strength training implements out there. The sandbag is a great functional training tool because it is an awkward unstable weight, which makes our core have to work harder to stabilize with many basic movements. The exercise was performed with (2Kg) according to OMNI-Resistance Exercise Scale (Appendix 1).

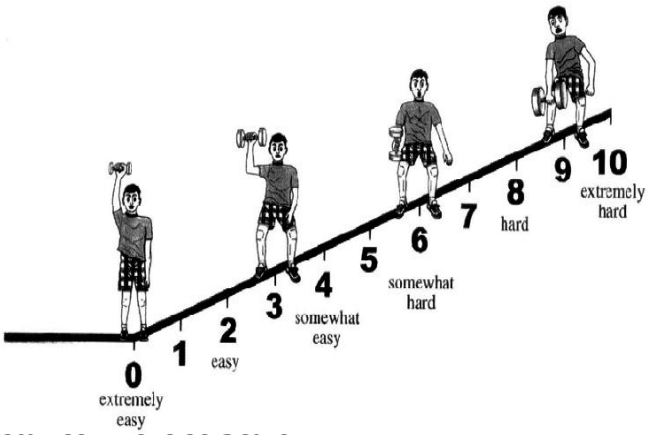


Fig (2): OMNI-Resi

Methods

Methods for assessment

1. **History taking:** Personal history (name, age, address and telephone number) and detailed medical history were taken from each patient of both groups (A&B) before the treatment.
2. **Body mass index**: Body mass index (BMI) was calculated for each patient

through the following equation:

BMI (Kg/m2) = weight (Kg) / height2 (m2)

3. **Blood glucose leve**l: Two hours glucose tolerance curve was performed for all patients in both groups (A&B) at the start of the study and after 12 weeks of treatment program. All patients at the start of this study had undergone two hours 75-gm. OGTT (75-gm. oral glucose load administered in a fasting state). Biochemical analyses of blood were performed on fresh samples in a core laboratory facility. The test was performed in the morning after 8 hours fasting. Blood glucose values were measured while fasting and two hours postprandial after the ingestion of 75-gm. of glucose. This test was repeated after 12 weeks of treatment program for each patient in this study.
4. **Target Heart Rate (THR)**: THR was calculated to determine the exercise intensity for each individual (**20).**

THR = RHR + (MAX HR – RHT)

MHR = 208 – (0.7 * age)

Exercise intensity = 70% of target HR

5. **OMNI-Resistance Exercise Scale**: To control intensity during resistance exercises by the patients themselves (**15**).

Intervention

Preparation for both groups

Intervention for group (A):

- ❖ General guide lines that regulate the glycemic response to exercise can be summarized as follow according to **(12)**
- ❖ Every patient was instructed to his\her insulin therapy and his\her breakfast 1 hour prior to the treatment session to avoid hypoglycemia.
- ❖ Avoid exercise if fasting blood glucose levels are >250mg/dl and ketosis is present, and caution if glucose level are >300mg/dl and no ketosis is present.
- ❖ Blood glucose monitoring before and after exercise.

- ❖ Learn the glycemic response to different exercise conditions.
- ❖ Consume added carbohydrate as needed to avoid hypoglycemia.
- ❖ Carbohydrate-based foods should be available during and after exercise.

- All patients in group A received aerobic exercise program 3 sessions per week for 12 successive weeks. The session lasted for 40 minute and it included:

1- **Warming up**: The first five minutes was exercise in the form of stretching for lower limb muscles and low intensity cycling group A. **Fig (3)**

Fig (3): Warm up exercise

2- **Active phase**: Twenty minute of using treadmill with exercise intensity 70% of target heart rate. **Fig (4)**

Fig (4): Treadmill exercise

- **Cooling down:** Thelast five minutes of the session was exercise in the form of active stretching for lower limb muscles **(21). Fig (5)**

Fig (5): Cooling down: stretch of calf muscle

Intervention for group (B):

• Progressive resistance training (PRT) requires that muscles contract against an opposing force generated by some type of resistance (e.g., sandbag).

• The resistance exercise (RE) program consisted of circuit type resistance training elaborated in such a way that the main muscle groups of the patients were exercised: hip extensor, knee extensor, planter flexor.

• A circuit series was defined as a sequence of these four exercises (stations). Every patient performed 15 repetitions for each exercise, with a minimum resting period of 30 seconds and a maximum of 1 minute between each set.

• Exercise sessions lasted 30 minutes, starting with a 5-minute warm up and ending with a cool down. Participants exercised 3 times weekly on non-consecutive days for at least 3 months and performed 2 sets of 15 repetitions (reps).

• The exercises were performed without weights first for at least 1 week. Once a participant was able to properly complete 2 sets of 15 reps, resistance was added. Free weights were attached to the distal limb at the ankle **(21).**

Resistance exercise:

Fig (6): Resistance training of knee extensor

Fig (7): Resistance training of hip extensor

Fig (8): Resistance training of ankle planter flexor

Statistical analysis:

Descriptive statistics and t-test were conducted for comparison of the mean age, weight, height, BMI of both groups.T-test for comparison of two hours glucose tolerance test between both groups.Paired t test for comparison between pre and post treatment mean values of two hours glucose tolerance test in each group.The level of significance for all statistical tests was set at $p < 0.05$.

Results

The baseline patient physical characteristics are presented in table (1) and figure (9) showed no significant difference between the two groups (A and B) at baseline assessment regarding age, weight, height and BMI($p > 0.05$).

Figure (10) the pre-treatment comparison of mean values of blood glucose level fasting blood glucose level and post prandial blood glucose level showed no significant difference between the two groups.

Figure (11) showed that was a significant decrease in the fasting blood glucose level and post prandial blood glucose level of group (A) post treatment with aerobic exercise compared with pre –treatment.

Figure (12) showed that a significant decrease in the fasting blood glucose level and post prandial blood glucose level of group (B) post treatment with resisted exercise compared with pre-treatment. Figure (13) there was a significant decrease in the fasting blood glucose level of group (A) compared with that of group (B) post treatment.

Table (1): Descriptive statistics and t-test for comparing the mean age, weight, height and BMI of both groups

Group / Items	Group A	Group B	MD	t- value	p-value	Sign
	$\overline{X}$ ±SD	$\overline{X}$ ±SD				
Age (years)	12.26 ± 1.33	12.33 ± 1.44	-0.07	-0.13	0.89	**NS**
Weight (kg)	٤٥.٣٢ ± ٣.٥٧	٤٤.٨٧ ± ٤.٦٣	0.45	0.3	0.76	**NS**
Height (cm)	148.86 ± 3.79	151.2 ± 5.7	-2.34	-1.32	0.19	**NS**
BMI (kg/m²)	20.47 ± 1.7	19.77 ± 1.11	0.7	1.32	0.19	**NS**

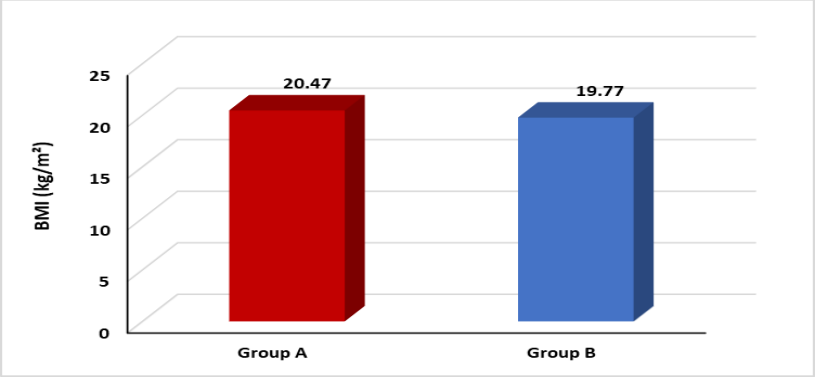


Fig (9): Mean BMI for both groups (A and B)

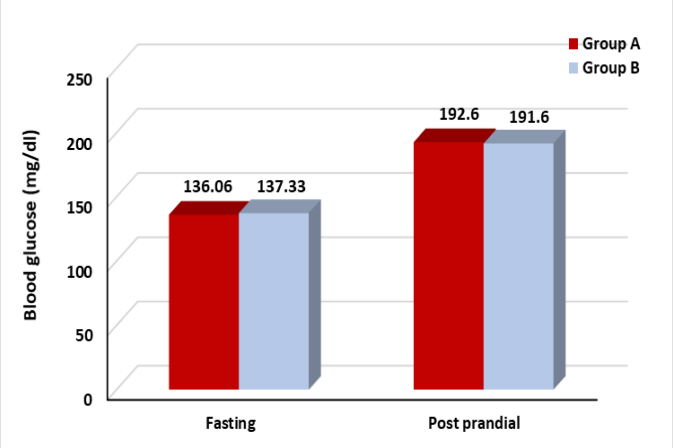


Fig (10): Pre-treatment mean values of blood level glucose of both groups (A&B)

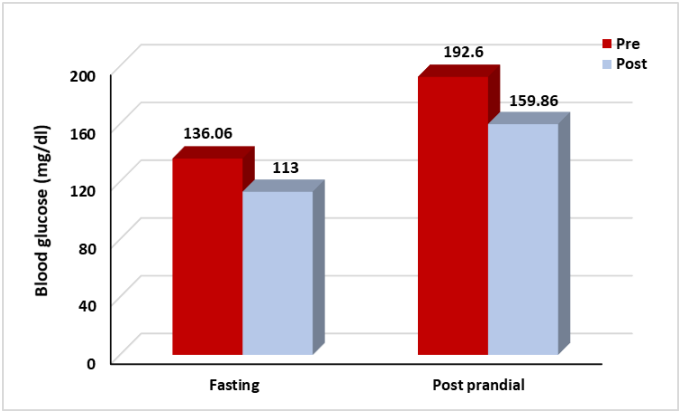


Fig (11): Pre and post treatment mean values of blood glucose level of group A.

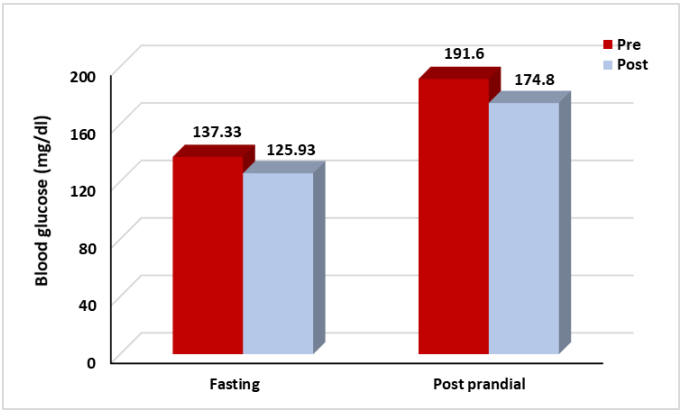
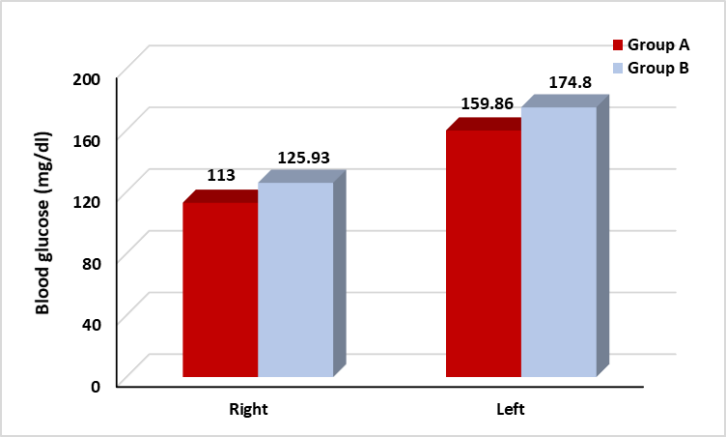


Fig (12): Pre and post treatment mean values of blood



glucose level of group B.

Fig (13): Comparison between post treatment mean values of blood glucose level of both groups (A&B)

Discussion

This study aimed at comparing the efficacy of aerobic exercise versus resistive exercise on glycemic level in juvenile diabetes mellitus; in addition to a designed aerobic exercise significantly improve blood glucose level and resisted exercise.

The results are in agreement with **(18)** who found that both resistive and aerobic exercises protocols were effective in reducing blood glucose level, but aerobic exercise produce more significant reduction in blood glucose level as compared to resisted exercise.

The significant reductions of FBG and PPBG after three months of aerobic exercise match with previous study conducted by **(7)** as a literature search to discuss the practical aspect of safe physical activity and sports participation in children and adolescents with type 1 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.

These results were in agreement with that of **(17)** who evaluated the impact of months exercise program on glycemic control in a sample of 196 adolescents with T1DM. They approved that exercise improves glycemic control. They explained that as exercise has an insulin-like effect on glucose, enhancing its uptake into cells and counteracting elevated blood glucose levels.

(14) stated thatsignificant reductions of fasting blood glucose level (FBG) and post prandial blood glucose level (PPBG) were also confirmed by a study to examine the acute glucose lowering effects of aerobic exercise in fifty children and adolescents with T1DM. Exercise session consisted of four 15 minute periods of walking on treadmill to a target heart rate of 140 beats per minute and three 5 minute rest periods. Prolonged moderate aerobic exercise results in a consistent reduction in plasma glucose

(7&8) stated that glycemic impact of resistance exercise in adults and children with type1 diabetes remains unclear. It may lower the risk of developing exercise-induced hypoglycemia in type 1diabetes. When both aerobic and resistance exercise are undertaken during a solitary activity session, it has been shown that doing the bout of resistance work first may actually help maintain glycemic balance more than when aerobic exercise occurs before resistance training . Varying the order of the activities based on blood glucose levels may minimize the risk of hypoglycemia.

(22) reported that effects of resistance exercise on glycemic control in T1D are still controversial, not univocally ascertained, but promising. For instance, resistance training has been shown to be effective in minimizing risk of hypoglycemia post-exercise in T1D.

(8)that stated only study investigating the resistance effect on glycemic control presented a positive tendency, although there was no statistically significant effect. One of the possible reasons for these varied

results could be the small sample sizes. The glucose profile varies greatly in patients with T1DM before, during and after exercise, and can be very different in patients with similar HbA1c.

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