

Effect of Pilates Exercise on Cardio Metabolic Risk Factors in Women with Type 2 Diabetes

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Abstract

Background: Diabetes mellitus represents a syndrome of complex metabolic diseases united by the occurrence of hyperglycemia which also exhibits diverse origins (insulin deficiency, insulin resistance, systemic consequences of pregnancy) and has variable accompanying physiological and metabolic disorders leading to increase incidence and frequency of chronic complications due to micro vascular (e.g., nephropathy and retinopathy) and macro vascular (stroke, macro vascular coronary and peripheral artery diseases) alterations, as well as the difficulties of controlling it.

Aim of Study: The current study intended to determine the effect of pilates exercises on cardio metabolic risk factors in patients with type 2 diabetes.

Patients and Methods: Forty women with type 2 diabetes, aging from 35 to 55 years with 5-7 years ago suffering from diabetes, they were assigned randomly into two groups of equal numbers, control and study. Women in controlled group received regular medical treatment with no change on their regular daily activities. Those in the study group received a designed pilates exercises three days/week for 12 weeks. Blood samples were collected and were subjected to laboratory investigations for glycosylated hemoglobin and lipid profile analysis, measure blood pressure, waist-hip ratio, before intervention, and were repeated after twelve weeks of treatment.

Results: Pre and post-treatment comparisons showed a statistically significant improvement of the measured variables in the two groups. Moreover, significant difference was recorded in the study group.

Conclusions: Designed pilates exercises contributed to improve cardio metabolic risk factors in patients with type 2 diabetes.

Key Words: *Pilates exercises – Diabetes mellitus – Cardiovascular risk factors.*

Introduction

DIABETES mellitus is a complex and heterogeneous group of chronic metabolic diseases that are characterized by hyperglycemia, type 2 diabetes is a progressive metabolic disease that is characterized by insulin resistance and eventual functional failure of pancreatic beta cells [1].

Hyperglycemia is the major risk factor for micro vascular complications in patients with Type 2 Diabetes (T2D). However, lowering HbA1c has only a modest effect on reducing CVD risk and mortality [2].

People with T2DM have approximately a 2-4-fold increase in the risk for coronary heart disease, stroke, and death from vascular causes compared to those without T2DM [3].

Adults with diabetes have a 77-87% prevalence of hypertension, a 74-81% prevalence of elevated Low-Density Lipoprotein Cholesterol (LDL-C), and a 62-67% prevalence of obesity [4].

Concerns about cardiovascular disease in type 2 diabetes have traditionally focused on atherosclerotic vasculo-occlusive events, such as myocardial infarction, stroke, and limb ischemia. However, one of the earliest, most common, and most serious cardiovascular disorders in patients with diabetes is heart failure [5].

Regular physical activity has many advantages, it reduces not only the risk of cardiovascular events (including sudden cardiac death; by 20%-30%) but also the degree of being over weight and obesity; diminishes the risk of hypertension, diabetes mellitus, and thromboembolic complications; improves

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exercise tolerance, blood lipid profile, and functions of the endothelium and microcirculation; exerts a positive influence on the homeostasis system; reduces the risk of muscle and bone disease; boosts immunity, sleep, and sexual function; and reduces the risk of cancer [6].

Pilates is one of the training methods which are very popular, they have lower intensity compared to aerobic exercises, and has very positive effects on health such as decreasing cardiovascular risk, practice of pilates showed an improvement in body composition in healthy people [7].

After applying pilates exercises and low calorie diet on leptin levels and lipid profiles in sedentary women for 16 weeks result showed that serum leptin concentrations and Waist-Hip Ratio (WHR) showed significant changes within and between exercise and diet groups [8].

Purpose of the study:

To detect the effect of pilates exercises on cardio metabolic risk factors in patients with type 2 diabetes.

Design of the study:

Pre-post test design was used in this study.

Patients and Methods

Patients and methods: They were selected randomly and referred by the physician of internal medicine from the out patient clinic of internal medicine in El-Monira Hospital and they were operated in the Department of Physical Therapy at El-Monira Hospital one of the Egyptian Health Ministry Hospitals in Cairo. The study was conducted from February 2018 to July 2018. Forty women with type 2 diabetes, were randomly assigned into two groups equal in numbers; each group consisted of twenty patients. The first group (group A) received pilates exercises and the second group (group B) received only their medications, both groups were under their medical treatment prescribed by the physician. Inclusion criteria, all patients were women with type 2 diabetes from 5-7 years at least, patients' age range from 35 to 55 years, all patients undertook their hypoglycemic drugs, body mass index ranged from (30-35kg/m²) class I (moderate obesity). Patients excluded from the study if they had any neuropsychiatric conditions (for example, epilepsy, depression or panic disorder), patients with orthopedic or neurological problems that interfere with exercises, other diabetic micro vascular complications (for example, diabetic retinopathy) within the past three months, any

patient participate in other clinical trials within the past three months.

Patients were assessed before and after 12 weeks of treatment. Glycosylated hemoglobin assessed by HbA1c Uniten device, lipid profile assessed by lipid profile booked device, blood pressure (systole and diastole) assessed by Mercury Sphygmomanometer and Stethoscope and waist-hip ratio assessed by Tape Measure, borg scale used to set the exercises intensity.

Ethical consideration:

The study was approved from the Ethical Committee of Faculty of Physical Therapy, Cairo University, ensure that all patients were medically, physically and psychologically fit to participate in the study, all patients were informed about the nature and purpose of the study, what would occur during the experimental sessions with extended opportunity to ask questions, confidentiality were assured, all the enrolled diabetic women signed a written consent form prior to participation in the study.

Ethical consideration number: P.T.REC/012/001422.

Procedure:

Pilates exercise:

- *Mode of exercise:* The pilates training program sample (Table 1) [9].
- *Duration of exercise:* Each session include three phases:
 - An initial (7-10) minutes warm up phase in the form of (breathing, arm circles, hip rolls).
 - Pilates phase 40 minutes that consisted of 5 types of exercises (bent knee, shoulder bridge, side kick front, side kick back, single leg circle) duration of each one from 7-8 minutes.
 - Finally, cool down phase (7-10) minutes in the form of (neck stretch, knee stretch, breathing).
- *Frequency:* Exercise training was done three times per week for twelve weeks.

Table (1): The pilates training program sample [9].

Warm up	Exercises	Cool down
Breathing	The shoulder bridge	Neck stretch
Arm circles	Bent-knee	Knee stretch
Hip rolls	Side kick front	Breathing
	Side kick back	
	Single leg circle	

N.B.: Group (B) received only their medical treatment.

Statistical analysis:

Descriptive statistics and *t*-test was conducted for comparison between both groups. Paired *t*-test was conducted for comparison between pre and post-treatment in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical measures were performed through the Statistical Package for Social Studies (SPSS) Version 19 for windows.

Results

Subject characteristics:

The present study revealed that application of pilates exercise, for 60 minutes every other day, for 12 weeks, results showed a significant decrease HbA1c (8.35% in study group, 4.16% in controlled group), TC (10.57% in study group, 1.69% in controlled group), TG (11.98% in study group, 4.93% in controlled group) and TG/HDL ratio (17.96% in study group, 4.15% in controlled group)

in both groups, significant decrease systolic blood pressure (9.1%), diastolic blood pressure (11.89), LDL (17.03), WHR (9.13%) and significant increase HDL (7.96%) in study group. Non significant change systolic blood pressure (0.92%), diastolic blood pressure (0.68%), LDL (1.24%), HDL (1.17%), and WHR (0.1%) in controlled group, with significant difference between both groups in blood pressure (systole, diastole), lipid profile and Waist Hip Ratio (WHR).

The baseline patient physical characteristics are presented in (Table 2) showed no significant difference between the two groups at baseline assessment regarding age, weight, height and BMI assessment.

Table (3) show the post-treatment comparison of mean values of cardio metabolic risk factors Fig. (1). Significant difference between the two groups between all variable except HbA1c was recorded in favor of the study group.

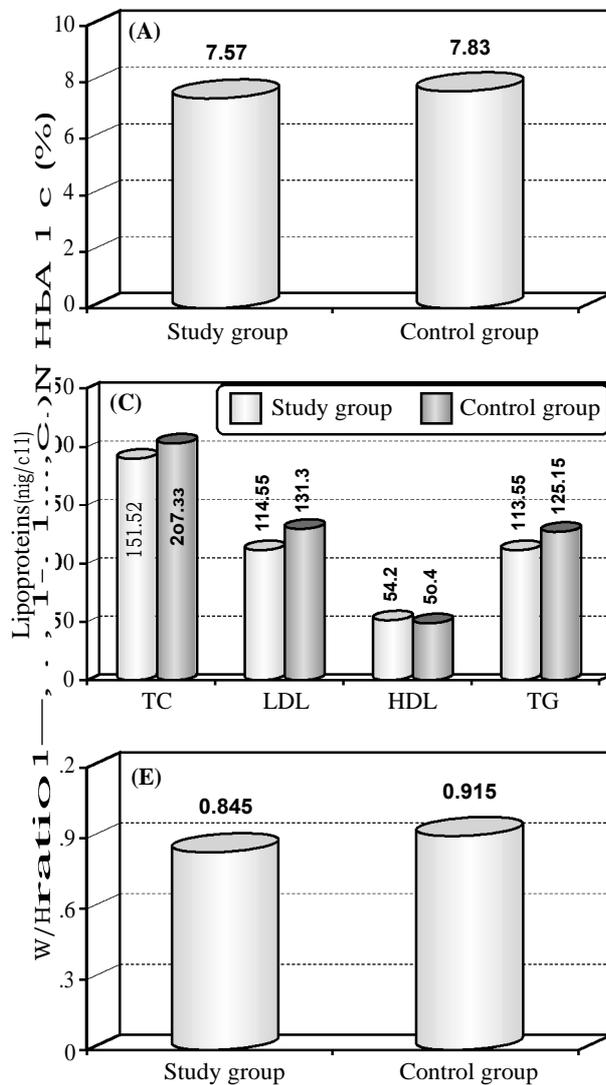


Fig. (1): Show the post-treatment comparison of mean values of cardio metabolic risk factors (A) HbA1c, (B) Blood pressure (Systolic, Diastolic) (C) Lipid profile (TC, LDL, HDL, TG) (D) TG/HDL ratio (E) Waist hip ratio.

Table (2): Patient physical characteristics at baseline.

	Study group X ± SD (SE)	Control group X ± SD (SE)	MD	t-value	p-value	Sig.
Age (years)	46±5.15 (1.15)	44.65±6.31 (1.41)	1.35	0.74	0.46	NS
Weight (kg)	85.35±3.4 (0.76)	86.02±3.52 (0.78)	-0.67	-0.61	0.54	NS
Height (cm)	159.65±2.81 (0.62)	160.45±3.18 (0.71)	-0.8	-0.84	0.4	NS
BMI (kg/m ²)	33.32±1.29 (0.29)	33.49±1.53 (0.34)	-0.17	-0.39	0.69	NS

X : Mean. MD : Mean Difference. p-value : Probability value.
SD : Standard Deviation. t-value : Unpaired t-value. NS : Non Significant.
SE : Standard Error.

Table (3): t-test for comparing post-treatment mean values of cardio metabolic risk factors between control and study groups.

Item	Study group X ± SD (SE)	Control group X ± SD (SE)	MD	t-value	p-value	Sig.
HbA1 c	7.57±0.4 (0.08)	7.83±0.75 (0.16)	-0.26	-1.39	0.17	NS
Systolic blood pressure	127.25±7.51 (1.68)	139.2±7.7 (1.72)	-11.95	-4.96	0.0001	S
Diastolic blood pressure	77.75±5.49 (1.22)	86.9±5.87 (1.31)	-9.15	-5.08	0.0001	S
TC (mg/dl)	191.92±20.28 (4.53)	207.33±22.27 (4.98)	-15.41	-2.28	0.02	S
LDL (mg/dl)	114.95±16.9 (3.77)	131.3±19.63 (4.39)	-16.35	-2.82	0.008	S
HDL (mg/dl)	54.2±3.59 (0.8)	50.4±3.23 (0.72)	3.8	3.51	0.001	S
TG (mg/dl)	113.85±22.01 (4.92)	128.15±14.69 (3.28)	-14.3	-2.41	0.02	S
TG/HDL	2.1±0.39 (0.08)	2.54±0.31 (0.06)	-0.44	-3.93	0.0001	S
WHR	0.845±0.05 (0.01)	0.915±0.05 (0.01)	-0.07	-4.03	0.0001	S

X : Mean. MD : Mean Difference. p-value : Probability value.
SD : Standard Deviation. t-value : Unpaired t-value. S : Significant.
SE : Standard Error.

Discussion

The study was conducted to determine the effect of pilates exercises on cardio metabolic risk factors in patients with type 2 diabetes.

Forty patients of women with type 2 diabetes, aged from 35 to 55 years with 5-7 years ago suffering from diabetes, were assigned randomly into two groups. (Group A) received pilates exercises; and (Group B) who received only their medications. All patients received 3 sessions per week for successive 12 weeks.

According to the 2008 Canadian Diabetes Association guidelines, the main interventions for reducing risk of CVD include controlling blood glucose and blood lipid levels, as well as controlling BP include maintenance of SBP <130mmHg [10].

For each 1% increase in the level of HbA1c, the relative risk of CVD increases by 1.18%, whereas each 1% decrease in HbA1c levels is associated with a 37% reduction in micro vascular complications and a 14% reduction in myocardial infarctions [11].

Further, lowering HbA1c in patients with type 2 diabetes decreases the absolute risk of developing

coronary heart disease by 5-17% and all cause mortality by 6-15% Ten et al., [12].

The result of the current study agreed with the results of Hulya and Omer [13], who indicated that pilates-based mat exercises designed for women with T2D can be recommended as a part of a treatment program, there were significant differences in HbA1c, pain, fatigue, mental health-related QOL, anxiety, depression, and fasting blood glucose after 12 weeks of PBME.

Regarding to Snowling and Hopkins [14], reported in patients with type 2 diabetes significant reductions in fasting glucose, HbA 1 c and insulin sensitivity after dynamic endurance training, with some evidence of small additional benefits resulting from combining endurance and resistance training. Moreover, it was suggested that the effects were somewhat larger for those with a more severe disease status, in particular for HbA1c.

On the other hand, Yanagawa et al., [15], found no significant improvement in insulin resistance in elderly diabetes patients after a 12-week exercise program.

Furthermore, Gram et al., [16], evaluated two intervention groups walking at moderate intensity

or exercising; however, 4 and 12 months later, there was no difference in HbA1c in comparison to the control group.

Sanz et al., [17], said when planning an exercise program for patients with diabetes aiming to improve insulin sensitivity, the type, duration, and intensity of exercise are important parameters that must be considered.

Also the results of this study are also supported by Anna and Robert [18], reported that both aerobic and combined aerobic and Resistant Exercise (RE) were related to statistically significant declines in SBP (6mmHg and 3.59mmHg, respectively). Moreover, the mean SBP of the aerobic exercise trials ranged between 126 and 133mmHg at last follow-up (mean SBP=130mmHg), whereas the mean SBP of the combined aerobic and RE ranged between 129 and 138mmHg (mean SBP=134mmHg) at last follow-up. Therefore, aerobic and combined aerobic and resisted exercise have the potential to have a clinically significant impact on the presence of hypertension among individuals with type 2 diabetes.

Consistent with this study by Fernando et al., [19], showed that aerobic exercise leads to a significant reduction of blood pressure in resistant hypertension.

On the other hand, Erkal and Omer [20], after applied pilates for 8 weeks found significant decrease in systolic blood pressure but there was no effect on diastolic blood pressure of Pilates mat exercises, while Jago et al., [21], found no effect of the 4-week Pilates exercises upon the systolic and diastolic blood pressures of young women.

Regarding to this study, Arslanoğlu et al., [22], reported that regular pilates exercises are effective on reducing percent body fat of middle aged sedentary women.

Moreover, Hagner-Derengowska et al., [23], compared the effect of pilates and walking exercises on 196 overweight or obese women and they found lower effect of pilates exercise on HDL and LDL than walking exercise.

Furthermore, Gentile et al., [24], demonstrated that LDL cholesterol declined ($p<0.05$) in high-intensity resistance and cardiovascular training and a balanced diet group for a 12-week intervention.

Also, Azam et al., [8], found significant changes in triglyceride within groups were observed, these findings were consistent with study that carried

out by Frank et al., [25], but there were not change significantly in LDL-C, TC and HDL concentrations in two training and diet groups.

These findings were similar to those found by Krause et al., [26], however, the ratio of HDLC/ LDL C increased significantly within and between experimental groups.

Similar findings were demonstrated by Fontana et al., [27], found that improvements in lipid levels were more closely associated with exercise quantity than exercise intensity or improvements in fitness.

Also, Çakmakçı [28], who studied the effect of 8 week pilates exercise on body composition in obese women reported that significant differences between pre test and post test for weight, body mass index, waist circumference, supscapula, iliac, lean body mass, and basal metabolic rate in the experimental group ($p<0.05$).

On the contrary, Segal et al., [29], reported that no significant change in weight, body fat percentage, waist and hip circumference values was observed after applying one hour a week for six months pilates exercises on middle-aged women.

At the end, Sassen et al., [30], reported earlier, physical activity and physical fitness have been shown to be inversely associated with the clustering of metabolic abnormalities.

Conclusion:

We concluded that pilates exercises were effective for managing cardio metabolic risk factors in patients with type 2 diabetes. As there were highly significant differences in glycosylated hemoglobin, lipid profile, blood pressure (systole and distole) and waist-hip ratio after treatment.

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تأثير تمارين البايلتس على عوامل الخطر القلبية الأيضية في مرضى السكري من النوع الثانى

يعتبر داء السكري من أخطر الأمراض ويوصف بأنه أبو الأمراض حيث يرتبط به مجموعة من الأمراض تسمى أمراض التمثيل الغذائى وتتزايد نسبة الإصابة به فى مصر، فمن المتوقع أن تكون مصر فى عام ٢٠٢٥ من أكثر ١٠ دول فى العالم ينتشر بها المرض لإتباع النظام الغذائى الغربى الذى يتميز بكثرة السرعات الحرارية وقلة الحركة وزيادة الوزن.

الغرض من هذه الدراسة الكشف عن تأثير تمارين البايلتس على عوامل مخاطر الأيض القلبية فى المرضى الذين يعانون من مرض السكري من النوع الثانى، أجريت هذه الدراسة على أربعين سيدة من مرضى داء السكري من النوع الثانى وتراوح أعمارهم ما بين الخامسة الثلاثين والخامسة والخمسين عاماً، وتم إستبعاد المرضى المصابين بأمراض الجهاز الدورى التنفسى، أمراض الكلى، أمراض الأعصاب وأمراض الجهاز الحركى التى قد تعوق أداء المرضى للتمارين، وكانت النتائج: بعد إجراء التحليل الإحصائى حدوث إنخفاضاً مؤثراً ذو دلالة إحصائية فى مستوى الهيموجلوبين السكرى فى الدم، TG, TC, TG/HDL ratio، فى كلتا المجموعتين، تحسن مؤثراً ذو دلالة فى ضغط الدم الإنقباضى والإنبساطى HDL, LDL، نسبة محيط الخصر إلى الوسط فى المجموعة الأولى بينما فى المجموعة الثانية كان التحسن غير ملحوظ فى ضغط الدم الإنقباضى، ضغط الدم الإنبساطى HDL, LDL، نسبة محيط الخصر إلى الورك، بينما وجدت فروق ذات دلالة إحصائية عند مقارنة مرضى المجموعة الأولى بمرضى المجموعة الثانية فى ضغط الدم والدهون الثلاثية ونسبة محيط الخصر إلى الورك، لذلك فإن لتمارين البايلتس تأثير إيجابى على مخاطر الأيض فى مريضات السكري من النوع الثانى.