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The effect of eight weeks of yoga training at two different intensities on the risk of coronary artery disease and thrombosis indices in women with type 2 diabetes

Sanaz Salahpour[1], Mostafa Khani[1,2*], Saeid Dabbagh Nikoukheslat[1], Parvin Dehghan[3]

1. Department of Exercise Physiology, Faculty of Physical Education and Sports Sciences, University of Tabriz, Tabriz, Iran.
2. PhysioGenEx Lab, Faculty of Physical Education and Sports Sciences, University of Tabriz, Tabriz, Iran.
3. Student Research Center, Faculty of Health and Nutrition, Tabriz University of Medical Sciences, Tabriz, Iran.

Corresponding Author's Email: khani_ms@tabrizu.ac.ir

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Abstract

Background: Diabetes is one of the five leading causes of death worldwide, with its prevalence steadily rising. Cardiovascular disease (CVD) is the primary cause of mortality among individuals with diabetes. Exercise interventions, including yoga, are recognized for their potential in the treatment, management, and prevention of metabolic syndrome, type 2 diabetes, and their associated complications

Aim: This study aimed to assess the effects of 24 yoga sessions over eight weeks at two different intensities on coronary artery disease risk and thrombosis indices in women with type 2 diabetes.

Materials and Methods: A total of 30 sedentary women with type 2 diabetes (mean age: 55.83 ± 6.58 years, BMI: 27.61 ± 4.57 (kg/m2)) were randomly assigned to one of three groups: Hatha yoga, yoga with an ultimate fitness approach, and control group. The two intervention groups performed yoga sessions for one hour, three times a week, over eight weeks. Anthropometric variables, body composition, coronary artery risk (Framingham index), glycemic indices, lipid profiles, and D-dimer levels were measured pre- and post-intervention. Data analysis was done using statistical software SPSS (version 26). Data were analyzed using covariance analysis (ANCOVA)

Results: The yoga group with the ultimate fitness approach demonstrated a significant reduction in both the Framingham index and D-dimer levels compared to the control group ($p < 0.005$). The Hatha yoga group also showed a significant reduction in D-dimer levels ($p < 0.005$) but did not exhibit significant changes in the Framingham index compared to the control group.

Conclusion An eight-week yoga intervention at two different intensities demonstrated a reduction in the risk of coronary artery disease and thrombosis indices in women with type 2 diabetes. Moreover, the ultimate fitness yoga approach demonstrated superior improvements in cardiovascular risk indicators compared to both a control group and a Hatha yoga intervention.

Keywords: yoga; D-dimer; Framingham index; Diabetes mellitus, type 2; Cardiovascular disease

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1. Introduction

Type 2 diabetes is a prevalent metabolic disorder worldwide, characterized by impaired glucose metabolism (1, 2). According to the International Diabetes Federation (IDF), the global prevalence of diabetes among individuals aged 20–79 years was 10.5% (536.6 million people) in 2021, with projections estimating an increase to 12.2% (783.2 million people) by 2045. The prevalence is similar between men and women and is higher in urban (12.1%) than rural areas (3.8%) and in high-income (11.1%) compared to low-income countries (5.5%). Middle-income countries are expected to experience the greatest relative increase in diabetes prevalence between 2021 and 2045 (1.21 times), followed by high-income (2.21 times) and low-income countries (9.11 times) (3). Diabetes is associated with chronic hyperglycemia and metabolic dysregulation, resulting in complications such as hypertension, dyslipidemia, coagulation abnormalities, nephropathy, retinopathy, neuropathy, and cardiovascular diseases (CVD) (4). Individuals with type 2 diabetes are particularly prone to macrovascular complications, including atherosclerosis-related conditions such as stroke and heart disease, with a two- to fourfold increased risk of CVD mortality (5). Insulin resistance exacerbates arterial atherosclerosis, contributing to hypertension and elevated risks of stroke, myocardial infarction, and vascular damage (6, 7). The progression of atherosclerosis occurs in two stages: an initial gradual stage characterized by plaque formation and vessel narrowing, and a later acute stage involving plaque rupture, thrombus formation, and ischemic events (8). Risk factors in the first stage, known as “atherogenic factors,” include elevated cholesterol and low HDL levels, while factors in the second stage, termed “thrombogenic factors,” include increased blood coagulability (9). Additionally, hyperglycemia-induced osmotic diuresis and dehydration raise blood concentration, leading to hyperosmolarity and increased thrombosis risk. If left untreated, this can result in severe complications or death (10). Diabetes mellitus significantly elevates the risk of thrombosis through a multifaceted pathophysiology. Chronic hyperglycemia induces endothelial dysfunction, characterized by reduced nitric oxide production and increased endothelin-1 and adhesion molecule expression, fostering a prothrombotic environment. Platelets in diabetic individuals exhibit heightened activation and adhesion, coupled with increased thromboxane A2 production. Furthermore, coagulation is enhanced by elevated levels of fibrinogen and Factor VII activity, while fibrinolysis is impaired due to increased plasminogen activator inhibitor-1 (PAI-1). This combination of endothelial damage, platelet hyperactivity, coagulation abnormalities, and impaired fibrinolysis collectively promotes a procoagulant state, markedly increasing the propensity for arterial and venous thrombotic events in the diabetic population (7, 9, 11). D-dimer, a fibrin degradation product, is a critical biomarker for detecting thrombotic events.

Elevated D-dimer levels indicate increased fibrin turnover and are linked to conditions such as venous and arterial thrombosis, pulmonary embolism, disseminated intravascular coagulation, and systemic diseases like diabetes and chronic inflammation (11). The D-dimer test is a standard diagnostic tool for blood clots, including those in the coronary arteries responsible for myocardial infarction (12). Cardiovascular risk factors, extensively studied in the Framingham Heart Study since 1948, identify modifiable contributors such as dyslipidemia, hypertension, smoking, and diabetes, along with secondary factors like physical inactivity, obesity, and psychological stress (13). Notably, exercise training has shown promise in improving cardiac function and mitigating pathological cardiac remodeling in heart failure patients (14). Similar benefits have been observed in experimental models of myocardial infarction and diabetes (14-16). Yoga, an ancient mind-body practice originating in India, has gained global popularity for managing diabetes, hypertension, and insulin resistance (17). Its accessibility, safety, and suitability for individuals of all ages and abilities make it an appealing intervention. Research indicates that yoga improves lipid profiles, blood glucose levels, insulin resistance, and cardiovascular risk factors such as body composition, inflammation, and oxidative stress (18, 19). Additionally, yoga enhances autonomic regulation and parasympathetic function, further supporting cardiovascular health (20, 21).Given yoga's low cost, minimal equipment requirements, and wide applicability, it offers a practical, side-effect-free intervention with substantial psychological and physiological benefits (22). On the other hand theoretical basis for examining varying intensities stems from the understanding that exercise intensity can differentially impact physiological responses, including metabolic and hemodynamic changes that may influence coagulation. It is hypothesized that a higher intensity yoga practice may elicit a more pronounced effect on mitigating the pro-thrombotic state associated with type 2 diabetes, offering a more potent intervention compared to a lower intensity or control condition (7, 14). According to the studies mentioned, no study has yet investigated the effect of eight weeks of yoga training at two different intensities on the risk of coronary artery disease and thrombosis indices in women with type 2 diabetes. The aim of this study was to evaluate the effect of eight weeks of Hatha Yoga and Ultimate Fitness Yoga practice on coronary artery disease and thrombosis risk indices in women with type 2 diabetes.

2. Methods and Materials

2.1. Study Design

This quasi-experimental study employed a pre-test and post-test design conducted in both field and laboratory settings. The participants were selected from a population of women with type 2 diabetes in Tabriz, Iran, aged 45 to 65 years, following a public call for participation in the city and through online platforms. The study was approved by the Ethics Committee at the Research Center of Tabriz University and conducted accordingly. Participants who expressed willingness to participate were briefed about the study's objectives, and informed consent was obtained. Demographic information was collected through questionnaires, and all volunteers underwent medical examinations to rule out cardiorespiratory or other untreated conditions.

2.2. Participant Selection

Thirty eligible women were selected based on inclusion criteria: non-menopausal status, no history of chronic disease or medication use, and no prior exercise experience in the past year. Participants were randomly divided into three groups: (1) control group (n=10), (2) yoga with an ultimate fitness approach (n=10), and (3) Hatha yoga (n=10). An introductory session was held one week before the intervention to familiarize participants with the exercises.

2.3. Anthropometric and Physiological Assessments

Height was measured to the nearest 0.1 cm using a stadiometer (Saka, Germany) while participants stood barefoot. Body composition, including fat percentage and fat-free mass, was assessed using the bioelectrical impedance method (InBody 270). Measurements were performed pre- and post-intervention under standardized conditions: no exercise 12 hours prior, fasting for four hours, no diuretic or medication use for seven days, and urination 30 minutes before testing. Blood pressure was measured three times with two-minute intervals using a standard mercury sphygmomanometer, and the average of the final two readings was recorded. Coronary heart disease (CHD) risk was assessed using the Framingham Heart Study table, which considers factors such as age, total cholesterol, HDL-C, systolic blood pressure, and smoking status.

2.4. Blood Sampling and Biochemical Analysis

Fasting blood samples were collected from the elbow vein 24 hours before and 48 hours after the intervention. Standard protocols were followed to minimize bruising and discomfort, and instructions on post-sampling care were provided. Blood samples were centrifuged **(3000** rpm for 10 minutes), and Serum samples were used to analyses the lipid profile of the participants, including the quantification of total cholesterol, LDL-C and HDL-C cholesterol, and triglycerides using colored enzymatic methods with commercial kits (Cholesterol CHOD-PAP and Triglycerides GPO-PAP; Pars-Azmone, IRI) on an automatic analyzer (Abbott, model Alcyon 300-USA). FBS concentration was measured by the enzymatic methods using an Abbot Model Aclyon 300, USA auto analyzer with kits from Pars-Azmone (Tehran, Iran). Glycosylated hemoglobin (HbA1c) was determined in whole blood using an automated high performance liquid chromatography analyzer with commercially Bio-Rad D-10 Laboratories, Schilti-gheim, France kit

2.5. Exercise Protocol

The two intervention groups participated in yoga sessions three times a week for eight weeks, with each session lasting one hour. The chosen practice sequence, The chosen practice sequence, 'Surya Namaskar,' included 19 asanas: Namaskarasana, Urdhvanamaskarasana, Hastapa dasana, Ekapadaprasaranasana, Dvipadaprasaran asana, Bhudharasana, Sashtangapranipatasana, Bhujangasana, Shashankasana, Ekapadaprasaran asana, Hastapadasana, and Namaskarasana. Within this sequence, exercises progressed from moderate to high intensity following the principle of overload. The key distinction between the Hatha Yoga group and the Ultimate Fitness Yoga group lay in the intensity and duration of the postures, as well as the transition speed between asanas. Though high intensity exercise may raise the risks of ischemia or hypoglycemia for women with diabetes, the pre-participation medical evaluation, health monitoring and glucose measurement, and the presence of trained yoga instructors diminished the possibility of adverse side effects (23).

Hatha Yoga Group: Exercises were performed at 65–75% of maximum heart rate (HRmax), starting at 65% and increasing gradually to 75%. Intensity was adjusted every two weeks, with repetitions progressing from 8 to 16 per session (23).

Ultimate Fitness Yoga Group: Exercises were performed at 80–95% of HRmax, beginning at 80% and progressively reaching 95%. Intensity increased by 10% every two weeks, with repetitions also progressing from 8 to 16 per session (24).

Heart rate was monitored using Polar heart rate monitors, and exercise intensity was calculated using the Karvonen method. Energy expenditure during sessions was estimated using the following formula (25, 26):

Target Heart Rate = [(max HR − resting HR) × %Intensity] + resting HR

Female: (age x 0.074) - (weight x 0.05741) + (heart rate x 0.4472) - 20.4022)] x time / 4.184

2.6. Statistical Analysis

Descriptive statistics were used to summarize data, and normality was assessed using the Kolmogorov-Smirnov test. Homogeneity of variance was tested using Levene's test. Parametric covariance analysis (ANCOVA) was performed to evaluate group differences using SPSS software (version 26) at a significance level of $p<0.05$. Graphs were created in Graph Pad prism -10

3. Results

In this study, a total of 30 participants were selected as the statistical sample and randomly divided into three experimental groups. Table 1 presents the descriptive statistics for these groups as mean ± standard deviation. The normality of the data distribution was assessed using the

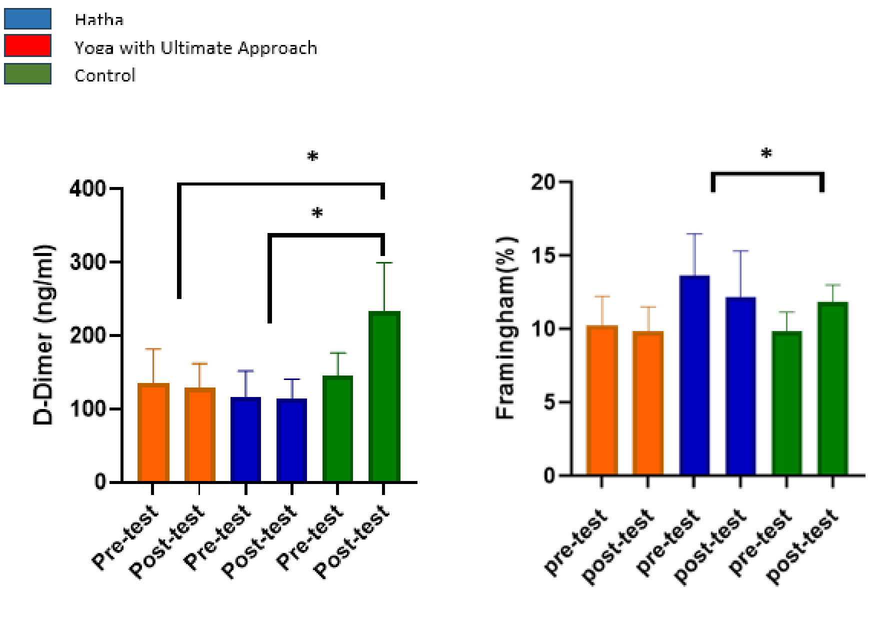
Kolmogorov-Smirnov (K-S) test at a significance level of $P < 0.05$, with the results provided separately for each group in Table 2. Figure 2 illustrates the difference between the means of the variables in the pre-test and post-test among the three groups, displayed as a bar graph. As detailed in Table 1, the personal characteristics of the subjects in each group are as follows: The three experimental groups consisted of 10 middle-aged women with an average age of 55.83 ± 6.58 years, height of 160.16 ± 4.37 cm, weight of 71.68 ± 12.96 kg, and a body mass index of 27.61 ± 4.57 kg/m². These subjects presented with glycosylated hemoglobin levels above 6.5 and fasting blood sugar levels above 137.7, indicative of type 2 diabetes. Analysis of Covariance (ANCOVA) revealed significant group effects on both Framingham risk scores ($F(2, 18) = 3.736$, $p = 0.044$, $\eta^2 = 0.293$) and D-dimer levels ($F(2, 18) = 9.841$, $p < 0.001$, $\eta^2 = 0.522$), indicating that group membership significantly influenced these outcomes, accounting for 29.3% and 52.2% of the variance, respectively. Pre-test Framingham scores were also a significant predictor of post-test scores ($F(1, 18) = 24.691$, $p < 0.001$, $\eta^2 = 0.578$), while pre-test D-dimer levels were not ($F(1, 18) = 0.041$, $p = 0.841$, $\eta^2 = 0.002$). According to the results of the analysis of covariance for the Framingham variable, the pre-test effect is significant. The Framingham mean in the Hatha Yoga group did not decrease significantly compared to the control group ($P < 0.05$). The Framingham mean in the yoga group with the ultimate fitness approach decreased significantly compared to the control group ($P < 0.05$). The Framingham mean in the Hatha Yoga group did not decrease significantly compared to the Hatha Yoga group ($P < 0.05$). These findings suggest that practicing yoga with the ultimate fitness approach has a positive effect on reducing Framingham risk scores in women with type 2 diabetes. Similarly, the results of the analysis of covariance (ANCOVA) for the D-dimer variable indicated that the pre-test effect is not significant. The mean D-dimer level in the Hatha Yoga group did not decrease significantly compared to the control group ($P < 0.05$). The mean D-dimer level in the yoga group with the ultimate fitness approach decreased significantly compared to the control group ($P < 0.05$). The mean D-dimer level in the Hatha Yoga group did not decrease significantly compared to the Hatha Yoga group ($P < 0.05$). These results suggest that practicing yoga with the ultimate fitness approach has a positive effect on reducing D-dimer levels in women with type 2 diabetes. While statistically significant, the clinical relevance of these changes necessitates careful interpretation, considering established thresholds for meaningful change and further analysis to determine their impact on clinical outcomes.

Table 1: Descriptive information of subjects and variables (standard deviation ± mean)

Groups	Individual Characteristics	Hatha Yoga	Yoga with Ultimate Approach	Control	p-value
Age (years)		51.85 ± 3.89	55.83 ± 6.58	56.11 ± 5.44	0.984
Height (cm)		160.92 ± 6.24	160.16 ± 4.37	152.16 ± 1.57	0.916
Weight (kg)	Pre-test	73.6 ± 8.49	71.68 ± 12.96	66.90 ± 8.60	0.768
	Post-test	71.6 ± 8.15	71.03 ± 12.04	66.90 ± 8.60	0.917
BMI	Pre-test	28.41 ± 4.48	27.95 ± 4.8	28.86 ± 3.71	0.973
	Post-test	27.75 ± 4.42	27.61 ± 4.57	28.86 ± 3.71	0.931
Body Fat	Pre-test	35.3 ± 3.60	35.12 ± 5.4	34.10 ± 0.40	0.924
Percentage	Post-test	35.1 ± 3.7	35.6 ± 4.3	35.76 ± 1.35	0.894
FBS (mg/dL)	Pre-test	130.28 ± 18.24	137.77 ± 35.2	122.33 ± 10.74	0.533
	Post-test	111.28 ± 13.32	105.11 ± 15.1	122.33 ± 14.8	0.464
A1C	Pre-test	6.98 ± 0.81	7.3 ± 1.12	7.4 ± 0.23	0.507
(mmol/mol)	Post-test	6.7 ± 0.89	6.22 ± 0.49	5.831 ± 6.58	0.437

Table 2: Adjusted Mean Values ± SE of the Research Variables in the Post-test, Considering the Pre-test Values of Each Variable as Covariate

Tests		Df	Mean Squares	F	Significance Level	Eta Squared
Framingham	Slope Line	2	0.065	0.023	0.977	-
	Group Effect	2	9.435	3.736	0.044	-
	Pre-test	1	62.358	24.691	0.000	0.578
	Groups	2	9.435	3.736	0.044	0.293
	Error	18	2.526	-	-	-
D-Dimer	Slope Line	2	7982.2	1.072	0.205	-
	Group Effect	3	25815.92	2.237	0.136	-
	Pre-test	1	85.630	0.041	0.041	0.002 *
	Groups	2	20519.107	9.841	9.841	0.522
	Error	18	2085.208	-	-	-



(a) (b)

Figure 2. Performance Test Results (Mean ± SD). A) D-Dimer; B) Framingham; * Significant difference with the control group at the 0.05 level

4. Discussion

The results of the study showed that eight weeks of yoga practice with two different intensities had a positive effect on reducing the risk of coronary artery disease in women with type 2 diabetes. It seems that yoga practice with the ultimate fitness approach had a positive effect on reducing the Framingham index in women with type 2 diabetes, while Hatha yoga practice did not have a positive effect on reducing the Framingham index in women with type 2 diabetes. The results obtained in this part of the study were consistent with the findings of Kim-Innes et al. (2017). In a review study of the effectiveness of a short-term yoga-based lifestyle intervention program in reducing the Framingham risk score and 10-year cardiovascular risk estimate, 554 people were screened, and 386 people (252 women) were included in the analysis. They concluded that the yoga-based lifestyle intervention program significantly reduced cardiovascular risk, as shown by reductions in the Framingham score and 10-year cardiovascular risk estimate. It was also shown that yoga was beneficial in reducing various cardiovascular risk factors, including blood pressure, body mass index (BMI), lipid profile, and blood sugar, and that yoga practice improves cardiovascular health (27). In patients with diabetes, regular physical exercise combined with dietary modification has been shown to reduce BMI, increase high-density lipoprotein (HDL) levels, reduce triglyceride (TG) levels, and normalize blood pressure. During exercise, glucose transport into skeletal muscle is mediated by glucose transport proteins, particularly glucose transporter 4 (GLUT4), whose activity is influenced by contraction and insulin (28). Insulin activates the translocation of GLUT4 from the deep to the cell surface through complex signaling cascades, while muscle contraction activates AMP-activated protein kinase (AMPK) to translocate GLUT4. Insulin-stimulated GLUT4 translocation is generally impaired in individuals with type 2 diabetes. Both aerobic and resistance training increase GLUT4 expression and glucose uptake, even in patients with type 2 diabetes, with blood glucose levels decreasing for up to 16 hours post-exercise as signaling pathways for glucose uptake are activated (29). It is possible that high-intensity yoga training increases fat consumption after exercise due to energy requirements for returning H+ ions, resynthesizing glycogen, and increases in epinephrine, growth hormone, and energy demands (30). Yoga training patterns may also improve blood lipid concentrations, manifested as increases in HDL and HDL/TC and decreases in TG levels (31). This could result from increased mitochondrial number and size, elevated aerobic energy system enzyme activity, enhanced fat oxidation, and oxidation-facilitating enzymes (32). Additionally, performing yoga exercises with maximum readiness may lead to adaptations such as increased muscle oxidative capacity (e.g., capillary density), total hemoglobin levels, reduced glycolysis, enhanced end-diastolic volume, and stroke volume (33).

These changes are further supported by increases in arterial-venous oxygen difference, Krebs cycle enzyme activity, and electron transport. Cholesterol and insulin resistance—key contributors to high blood pressure—are mitigated through yoga practice, resulting in lower blood pressure (34). Yoga's ability to improve parasympathetic function also contributes to beneficial changes in lipid profile, reductions in cholesterol, blood pressure, and blood sugar, and decreases in insulin resistance (35). These combined factors can lead to reductions in the Framingham risk score and the likelihood of coronary artery disease. However, these results differ from those of Ghanadzadeh et al. (1400). In their study on the effects of continuous and intermittent exercise on fatty liver markers in women with type 2 diabetes, 30 participants performed intermittent exercise for 8 weeks, three sessions per week. While both exercise types significantly reduced total fat product indices and liver fat index, no significant reduction was observed in the Framingham index (10). This discrepancy may be attributed to differences in exercise duration, intensity, type, rest period, measurement techniques, grouping, participant age, obesity level, diabetes history, gender, or calorie intake (36). The results of the study also showed that eight weeks of yoga training with two different intensities positively impacted thrombosis indices in type 2 diabetics. It seems that yoga training with the ultimate fitness approach reduced the thrombosis index in women with type 2 diabetes, while Hatha yoga training did not. The findings of this part of the study align with those of Alireza Khademi et al. (1400), who investigated the effects of aerobic and resistance training on coagulation factors (PAI-1, fibrinogen, PT, PTT) and fibrinolysis markers (tPA, plasminogen, D-dimer) in sedentary obese women. They concluded that aerobic training had a better effect on key fibrinolytic factors (e.g., tPA), while resistance training better regulated coagulation variables like fibrinogen (37). Malekian-Fini et al investigated the effects of resistance training with and without blood flow restriction on coagulation indices and blood glucose levels in 41 type 2 diabetic patients. Their findings revealed that eight weeks of resistance training reduced fibrinogen levels, increased prothrombin time, and improved blood glucose control, effectively playing an insulin-like role. These results suggest that resistance training may help prevent thrombosis and the sudden onset of cardiovascular diseases in individuals with type 2 diabetes (38). Oxidative stress, a common condition in diabetes, results from an imbalance between reactive oxygen species (ROS) and antioxidants, leading to cellular damage (39). In response, the antioxidant system activates enzymatic (e.g., superoxide dismutase [SOD], catalase [CAT], and glutathione peroxidase [GPX]) and non-enzymatic antioxidants to neutralize ROS. Among these, CAT—a crucial iron-dependent enzyme—converts hydrogen peroxide (H_2O_2) into water in cellular peroxisomes, Yoga practice has been shown to reduce oxidative stress by increasing PGC1α expression, thereby enhancing the production of both enzymatic and non-enzymatic antioxidants, which scavenge free radicals and reduce ROS levels (40, 41). Reduced oxidative stress from yoga decreases leptin levels while increasing adiponectin, leading to reduced systemic inflammation (42). Consequently, the production of inflammatory cytokines, including interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), decreases, These cytokines influence the production of C-reactive protein (CRP) and fibrinogen in the liver, and their reduction lowers thrombosis risk. Furthermore, lower IL-6 levels increase plasminogen activator inhibitor-1 (PAI-1), which regulates fibrinolytic enzymes like tissue plasminogen activator (tPA). This cascade reduces thrombosis and the formation of D-dimer (43, 44). These findings are consistent with the results of Malekian-Fini et al (38), but contrast with Bijeh Nahid et al (45), who found no significant changes in fibrinogen and D-dimer levels after three months of aerobic exercise at 75–85% of maximum heart rate in middle-aged men. Additionally, Pars et al. observed that although eight weeks of aerobic training improved body composition in overweight middle-aged women, longer exercise durations were needed to observe significant biochemical changes (46, 47). These discrepancies may stem from variations in exercise protocols, participant characteristics (age, diabetes history, e.g), or measurement methods.

Addressing the inherent limitations of this pilot study is crucial for future research endeavors. Firstly, recognizing the exclusive focus on female participants and the potential for gender-specific physiological responses, subsequent investigations should incorporate both male and female subjects. These studies should rigorously examine the impact of varying yoga intensities on lipid profiles, markers of oxidative stress, body composition, and maximal oxygen uptake (VO2max), with careful consideration of potential confounding variables such as age, BMI, dietary habits, and pre-existing psychological stress levels. Secondly, acknowledging the relatively short eight-week intervention period, future research should explore the longitudinal effects of extended yoga interventions to fully elucidate the sustained benefits on cardiovascular health and overall well-being. Furthermore, given the established associations between obesity, hypertension, diabetes mellitus, and cardiovascular disease, future studies should investigate the effects of yoga on coronary artery disease risk and thrombotic markers in individuals with these co-morbidities.

5. Conclusion

The findings of the present study suggest that eight weeks of yoga practice at two different intensities effectively reduced the risk of coronary artery disease and improved thrombosis indices in women with type 2 diabetes.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

The study's initial idea and design were a collaborative effort by all authors. Mostafa Khani, PhD, wrote the first draft of the manuscript, performed the statistical analyses, and prepared the final version of the paper. Saeed Dabbagh Nikoukheslat, PhD, and Parvin Dehghan, PhD, contributed to the conceptual framework of the study. Sanaz Salahpour was responsible for the implementation of the study protocol, participant guidance, data acquisition, and manuscript preparation.

Ethical considerations

This study was conducted in full compliance with established ethical standards, encompassing informed consent, measures to prevent plagiarism, assurance against data fabrication or misconduct, avoidance of duplicate publication, and adherence to submission guidelines. The study received ethical clearance from Tabriz University (IR.TABRIZU.REC.1403.139).

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

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