Original Article

Effect of Yoga on Lipid Profile and C-reactive Protein in Women

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Abstract

Background: Few scientific studies have been conducted about the effect of yoga on biochemical variables such as total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglyceride (TG), and C-reactive protein (CRP) to lay a scientific foundation regarding benefits of yoga, but its effect is not clearly detected yet. This study was conducted to assess the effect of yoga on lipid profile and CRP in women. **Methods:** This research was designed as an interventional study. After reviewing inclusion and exclusion criteria, selected biochemical variables such as TC, HDL-C, LDL-C, TG, and CRP were measured for each participant. Yoga instruction was done three times a week for 26 weeks by an experienced yoga instructor. After 26 weeks of yoga intervention, the above-mentioned dependent variables were assessed. SPSS Ver. 16 was used for data analysis. **Results:** After a 26-week follow-up for participants, only 24 women had the necessary criteria to be included in the study. The mean TG was 157.33 ± 68.416 mg/dL and 134.33 ± 58.80 mg/dL before and after the intervention (P = 0.108), respectively. The mean TC was 234.83 ± 48.47 mg/dL and 183.33 ± 55.09 mg/dL before and after the intervention (P = 0.014), respectively. The mean HDL-C was 31.58 ± 14.22 mg/dL and 38.25 ± 13.5 mg/dL before and after the intervention (P = 0.118), respectively. The mean LDL-C was 171.75 ± 42.69 mg/dL and 142.91 ± 36.4 mg/dL before and after the intervention (P = 0.030), respectively. The mean CRP was 0.57 ± 0.22 mg/L and 0.71 ± 0.77 mg/L before and after the intervention (P = 0.779), respectively. **Conclusions:** The result showed that yoga reduced TC and LDL-C significantly, but had no significant effect on TG, HDL-C, and CRP.

Keywords: *Cholesterol, C-reactive protein , triglycerides, yoga*

Introduction

Complementary medicine attributes to a class of treatments and interventions that have not been mentioned in modern medicine.[1] Yoga is originated from ancient India.[2] It is a Sanskrit word meaning unity and oneness of mind and body, which has been used in Eastern cultures since 500 years ago. Recently, Western countries have shown interest in yoga and it is considered as one of the most important methods of complementary medicine in the United States.[3,4] Yoga is a collection of physical and sitting exercises (Asana), controlled breathing techniques (Pranayama), and relaxation exercises (Shavasana).[5] Yoga is not primarily a therapy, but medical and scientific studies have proved a significant role of yoga in treating some diseases such as carpal tunnel syndrome,[6] multiple sclerosis,[7] asthma,[8] mental health issues,[9] cancer,[10] irritable bowel syndrome,[11] hypertension,[12] quality of life,[13] coronary heart disease,[14] and chronic obstructive pulmonary disease[15] within the past two decades.

Low-density lipoprotein cholesterol (LDL-C), low high-density lipoprotein cholesterol (HDL-C), and hypertriglyceridemia play major role in the risk for cardiovascular disease. In addition, hypertriglyceridemia and low HDL-C level are associated with Type 2 diabetes mellitus and metabolic syndrome. Low HDL-C and hypertriglyceridemia are highly associated with dietary habits and lifestyle. Significant correlation was established between total cholesterol (TC) and National Income and Western Diet by International Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group. These factors have a major impact on the changes in profile lipid in Asian countries.[16-19]

Few scientific studies have been dedicated to the effect of yoga on biochemical

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variables such as TC, HDL-C, LDL-C, triglyceride (TG), and C-reactive protein (CRP) to lay a scientific foundation regarding benefits of yoga, but its effect is not clearly detected yet. Therefore, this study was conducted to assess the effect of yoga on TC, HDL-C, LDL-C, TG, and CRP in women.

Methods

Selection of variables

Researchers have investigated various scientific texts related to the effects of yoga on biochemical variables in books and scientific research papers, and the following variables were chosen considering performance and availability criteria.

Dependent variables: TC, HDL-C, LDL-C, TG, and CRP.

Independent variables: Yoga.

Study design: This research was designed as an observational and interventional study.

Study protocol

This study was approved by the Ethics Committee of Ilam University of Medical Sciences (registration code: ir.medilam.rec. 1393.236). Data were gathered by using questionnaires and laboratory tests. Yoga instructors who were authorized by physical education organizations were chosen. The sample size was calculated according to the prevalence of hypercholesterolemia in a systematic review by Tabatabaei-Malazy *et al.*[20] with the prevalence of 43% using the following formula = $1/d^2$ ($z^2P[1 - P]$).

In all, 60 non-pregnant women were chosen for the intervention. After obtaining an informed written consent, participants were provided with instructions regarding the importance of questionnaires, which included the following: (1) demographic information; (2) tobacco and alcohol use; (3) medication history with a concentration on medications that affect lipid profile and serum levels of CRP; and (4) history of diseases such as inflammatory, infectious, renal, hepatic and peripheral vascular diseases, thyroid diseases, cerebrovascular diseases as well as diabetes, dyslipidemia, and trauma.

Patients

Inclusion criteria consisted of 60 non-pregnant women age 15–50 years willing to participate in the study, whereas exclusion criteria included the following: (1) irregular yoga practice during the intervention; (2) patients with an intervening disease in lipid profile and serum levels of CRP; (3) using medications that affect lipid profile and serum levels of CRP; (4) history of diseases that affect lipid profile and serum levels of CRP; (5) participants with CRP higher than 10 mg/L; (6) significant change in diet and lifestyle during the intervention; and (7) not cooperating until the end of intervention.

Intervention

Selected biochemical variables such as TG, TC, LDL-C, HDL-C, and CRP were measured for each participant. Hatha yoga instruction was performed for 26 weeks, 3 times a weeks, while each session lasted 60–70 min (postures, breathing techniques, meditation) by an experienced yoga instructor. After 26 weeks of yoga intervention, the above-mentioned dependent variables were assessed.

Blood collection and laboratory tests

Participants were asked to sit comfortably on a chair. About 5 mL of venous fasting blood was collected from the left arm and stored in a stoppered container with an anticoagulant. The method, kit, and manufacturing country for the studied variables were as follows: (1) cholesterol assessment based on calorimetry, enzymatic analysis (CHOD-PAD), and endpoint measuring by photometric method using "Pars Azmun" kit (Iran); (2) LDL-C and HDL-C with the enzymatic method and 100 mg/dL standard cholesterol using PadtanTeb kit (Iran); (3) TG assessment based on calorimetry, enzymatic analysis (GPO-PAP), and endpoint measuring by photometric method using Pars Azmun kit; (4) assessment of serum levels of CRP by ELISA method using Abcom kit (UK). A clinical pathologist performed all steps.

Statistical analysis

Parametric and nonparametric tests including Wilcoxon and paired-samples *T*-test were used for data analysis [Table 1]. SPSS Ver. 17 was used for data analysis and $P < 0.05$ was considered significant.

Results

After a 26-week follow-up for participants, only 24 of them exercised regularly and had the necessary criteria to be included in the study [irregular yoga practice during the intervention (n = 19); intervening disease in lipid profile and serum levels of CRP (n = 5); using medications that affect lipid profile and serum levels of CRP or history of diseases that affect lipid profile and serum levels of CRP (n = 7); CRP higher than 10 mg/L (n = 1); significant change in diet and lifestyle during the intervention (n = 4)]. The mean age of subjects was 34.25 ± 6.2 years. One-sample Kolmogorov–Smirnov test was not significant for TC, HDL-C, and LDL-C ($P > 0.05$). Since they had a normal distribution, paired-samples *T*-test was used to analyze them.

Wilcoxon test was used for TG and CRP, since they do not have a normal distribution ($P < 0.05$) [Table 1]. Based on statistical analysis, there is no significant relationship between yoga intervention and HDL-C (P = 0.118), CRP (P = 0.779), and TG (P = 0.108) in women. On the other hand, yoga intervention had a significant effect on LDL-C decrease (P = 0.030) and TC decrease (P = 0.014) [Table 2].

Discussion

This study investigated the effect of a 26-week yoga training programs on plasma lipids and CRP in 24 healthy women. The results showed that yoga significantly reduced TC and LDL-C, but had no significant effect on TG, HDL-C, or CRP.

Based on the results of this intervention, the mean TG was 157.33 ± 68.416 mg/dL and 134.33 ± 58.8 mg/dL before and after the intervention, respectively, which indicates TG reduction in women after yoga intervention. Although yoga reduced the level of TG, it was not significant (P = 0.108), which is consistent with the study of Mercuri *et al.*[21] and Yang *et al.*[22] and not consistent with the study of Gordon *et al.*,[23] Malhotra *et al.*,[24] Rahimi *et al.*,[25] and Hordern *et al.*,[26] which confirmed a significant relationship.

Based on the results of the present intervention, the mean TC was 234.83 ± 48.47 mg/dL and 183.33 ± 55.09 mg/dL before and after the intervention, respectively, which indicates TC reduction in women after yoga intervention. In this study, yoga reduced the level of TC and there was a significant relationship before and after intervention (P = 0.014), which is consistent with the study of Mercuri *et al.*[21] and Rahimi *et al.*,[25] and is not consistent with the study of Gordon *et al.*,[23] Sayyed *et al.*,[27] and Hordern *et al.*[26]

Moreover, the mean HDL-C was 31.58 ± 14.22 mg/dL and 38.25 ± 13.5 mg/dL before and after the intervention, respectively, which indicates HDL-C increase in women after yoga intervention. Although yoga increased the level of HDL-C, it was not significant (P = 0.118), which was consistent with the study of Mercuri *et al.*[21] and Yang *et al.*[22] and was not consistent with the study of Gordon *et al.*,[23] Malhotra *et al.*,[24] Rahimi *et al.*,[25] and Sayyed *et al.*[27]

Several studies were dedicated to the effect of yoga on TG, HDL-C, and TC, and all of them confirmed the effect of yoga on the reduction of these two lipid profiles.[28-31]

On the other hand, the mean LDL-C was 171.75 ± 42.69 mg/dL and 142.91 ± 36.4 mg/dL before and after the intervention, respectively, which indicates LDL-C reduction in women after yoga intervention. In this study, yoga reduced the level of LDL-C and the relationship was not significant before and after the intervention (P = 0.030), which is consistent with the study of Gordon *et al.*,[23] Malhotra *et al.*,[24] and Sayyed *et al.*,[27] and is not consistent with the study of Mercuri *et al.*,[21] Yang *et al.*,[22] and Hordern *et al.*[26]

The mean CRP was 0.57 ± 0.22 mg/L and 0.71 ± 0.77 mg/L before and after the intervention, respectively. The

Table 1: Choosing parametric and nonparametric test

	Kolmogorov-Smirnov *Z*	Sig.	Test
TG - before	0.190	0.200	Non-parametric → Wilcoxon test
TG - after	0.263	0.022	
TC - before	0.149	0.200	Parametric → paired-samples *T*-test
TC - after	0.156	0.200	
HDL-C - before	0.159	0.200	Parametric → paired-samples *T*-test
HDL-C - after	0.178	0.200	
LDL-C - before	0.126	0.200	Parametric → paired-samples *T*-test
LDL-C - after	0.111	0.200	
CRP - before	0.281	0.010	Non-parametric → Wilcoxon test
CRP - after	0.357	0.000	

TG=Triglyceride, TC= Total cholesterol, HDL-C=High-density lipoprotein cholesterol, LDL-C=Low-density lipoprotein cholesterol, CRP=C-reactive protein

Table 2: Analysis before and after intervention

	Mean	SD	Mean differences	SD differences	*Z*	*t*	df	Sig.
TG - before	157.3333	68.41628	-	-	−1.609	-	-	0.108
TG - after	134.3333	58.79909						
TC - before	234.8333	48.47649	51.5	61.03427	-	2.923	11	0.014
TC - after	183.3333	55.08891						
HDL-C - before	31.5833	14.22200	−6.66	13.62039	-	−1.98732	11	0.118
HDL-C - after	38.2500	13.49832						
LDL-C - before	171.7500	42.69368	28.83	40.11536	-	2.490	11	0.030
LDL-C - after	142.9167	36.39045						
CRP - before	0.57167	0.221763	-	-	−0.280	-	-	0.779
CRP - after	0.7142	0.77318						

SD=Standard deviation, df=Degree of freedom, TG=Triglyceride, TC= Total cholesterol, HDL-C=High-density lipoprotein cholesterol, LDL-C=Low-density lipoprotein cholesterol, CRP=C-reactive protein

relationship between the groups before and after the intervention was not significant (P = 0.779). The study of Mehrabani *et al.* demonstrated that there was a significant CRP decline in both obese and non-obese groups after 19 weeks of aerobic exercises.[32] Since regular exercise decreases body fat percentage and fat is a source of IL-6 production, fat reduction decreases serum levels of cytokines and reduction in serum levels of IL-6 weakens the signaling pathway of CPR production. Improved physical readiness due to exercise physiology is the main reason for decline in levels of CRP.[33-36] However, this is not consistent with this study.

The difference in results of various studies can be attributed to the difference in intensity, duration, and environment (ground and water) of yoga training, the studied groups, and the difference in age and gender of participants.

Physical exercises such as yoga increase lipolysis and fatty acids in plasma and thus increase heart rate and blood flow, leading to energy production. Fatty acid-binding protein and fatty acid translocase are among fatty acid-binding proteins that facilitate the entrance and exit of fatty acids and physical activities increase cell substrates by increasing this protein. Furthermore, physical activities increase lipolysis and decrease fatty acids in body organs. Body mass reduction decreases cytokines release, increases nitric oxide (NO), decreases endothelial dysfunction, and decreases the risk of clot formation in the arteries.[21,25,37] According to the study of Cauza *et al.*, the short-term response of plasma cholesterol to physical activities is different in men and women. Normally, HDL-C increases in men, whereas TC decreases in women (regardless of lipoproteins that bind to them). LDL-C reduction depends on weight loss, changes in body composition, muscle mass increase, and body fat reduction.[38]

In this regard, various studies have been dedicated to the effect of yoga on the reduction of body mass index,[39,40] weight,[39-44] and body fat.[39,43]

One of the limitations of this study was small sample size. Since this study took 2 years to complete, many participants left the intervention and the remaining participants were provided with special offers and women did not cooperate as expected. Conducting larger studies and clinical trials is recommended.

Conclusions

The effect of yoga on TC, LDL-C, HDL-C, TG, and serum levels of CRP in women was assessed according to the results of this study. The effect of yoga intervention on HDL-C, CRP, and TG in women was not significant, whereas its effect on LDL-C and TC was significant. Complementary therapy like yoga is advised as a low cost and available method to reduce chemical medications and increase efficiency.

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Conflicts of interest

There are no conflicts of interest.

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