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The Effect of Eight Weeks of Yoga Practice with Weight along with Spirulina Supplement on Some Indicators of Metabolic Syndrome in Obese and Overweight Older Women

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ABSTRACT

Introduction: With the increase in the elderly population and their comorbidities, the need for appropriate prevention of their metabolic comorbidities is felt. This study aimed to evaluate the effect of yoga practice with weight and Spirulina supplement on some indicators of metabolic syndrome (Lipid profile) in older women.

Methods: This quasi-experimental study was conducted on 40 elderly volunteer women with a body mass index of 25-30kg/m^2 living in Bushehr who were randomly divided into four groups of 10 people (control, supplement (Spirulina), exercise, and exercise/supplement). The training protocol consisted of three 60-minute exercise sessions per week for eight weeks. Subjects took three 500g Spirulina supplement capsules thrice daily for eight weeks. Lipid profiles (total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL)) were measured at pretest and posttest phases. Student t-test and one-way analysis of covariance (ANCOVA) were used for statistical analysis with a significance level of P≥0.05.

Results: Yoga with weights, along with Spirulina supplementation, led to a significant decrease in total cholesterol (F=10.22), triglycerides (F=12.20), and LDL (F=16.47). In contrast, HDL increased significantly after eight weeks of exercise and supplement consumption (F=36.02).

Conclusion: The results have shown that practicing yoga with weights for eight weeks has good effects on metabolic indicators, especially with the supplement. Data proved that using Spirulina supplements for eight weeks could not produce a desirable result.

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Introduction

The proportion of elderly worldwide will increase from 12 to 22% between 2015 and 2050, showing a faster increase than other age groups [1]. The body's metabolic conditions play a leading role in the development and progression of some diseases in older adults, such as metabolic syndrome, which affects a quarter of older people [2-4]. Metabolic syndrome has well-known cardiovascular risk factors, including insulin resistance, physical inactivity, atherogenic dyslipidemia, obesity, and hypertension [5-7]. Weight loss and cardiovascular risk management through lifestyle modification are the main goals when metabolic syndrome includes lipid abnormalities [8].

Although aging is an irreversible and inevitable stage of life, physical activity is a practical tool for dealing with age-related problems [7, 9, 10]. Therefore, lifestyle changes, such as increasing physical activity and a low-calorie diet, are recommended as the first intervention to reduce blood lipids and metabolic complications [11, 12].

Regarding exercise interventions, regular exercise in older women with metabolic syndrome reduced fat percentage [13]. The metabolic benefits of resistance training are similar to those of aerobic training, and it can improve the physical performance of older adults at the same time [14]. Resistance training can increase muscle strength and size, reduce body fat, neutralize insulin resistance, and associate metabolic changes in middle-aged and older adults [15]. Strength training programs are not

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the same and do not have common goals because of the relationship of training goals and individual needs [16]. No research was found on the effect of yoga on patients with metabolic syndromes, but a recent comprehensive review found that yoga improves metabolic risk factors, including blood pressure, lipid profile, and body mass index (BMI) [17]. Asanas alone may not be effective for full-body strength training, but adding resistance equipment and other forms of movement can compensate [18, 19].

Various studies have shown the role of supplements in aging and age-related metabolic disorders [20, 21]. The researchers believe that aging exposes cells and tissues to different types of intracellular and extracellular stresses, which leads to chronic degenerative disorders and requires supplements to treat age-related disorders [20]. Spirulina, an herbal supplement, has an antioxidative role, is rich in essential fatty acids, and contains nutrients such as phycocyanin, chlorophyll, polysaccharides, and sulfolipids, which increase the body's energy [22, 23]. Studies have focused on the role of Spirulina on lipid profile [24-26]. Using Spirulina in diabetic patients, for example, showed lipid-lowering potential in a double-blind study by Rostami et al. These results and other studies have illustrated the role of Spirulina as a functional food for older adults, suggesting that Spirulina would be very efficient in regulating metabolic abnormalities in older adults, especially postmenopausal [27, 28].

The popularity of yoga as a form of fitness and physical exercise added this new dimension of combining light dumbbell exercises with powerful yoga moves. Yoga with weight (Iron Yoga) is an incredibly intense, challenging, full-body workout because of a series of upper-body exercises while balancing on one leg, such as pressing above the shoulder, pressing the chest, and biceps [29]. Yoga exercise with weight and Spirulina supplementation has been studied on some biomarkers of metabolic syndrome and lipid profile in elderly obese and overweight women. Thus, this study evaluates the possibility of this goal by practicing yoga with weights.

Materials and Methods

Participants and Study Design

This semi-experimental and practical study was conducted with pretest and posttest. In this research, 40 older women were selected according to the inclusion criteria after announcing and selecting the volunteer subjects. The inclusion criteria were residency of Bushehr, women 60-65 years old, body mass index 25-35kg/m^2, sedentary lifestyle, and lack of regular training history in the last six months. The exclusion criteria included patients with autoimmune diseases and diabetes, irregular participation in the training program, any injury or physical problem, and inability to continue training. Changes in the treatment and medication program, sports exercises except for the research protocol, and lack of consent to continue the research caused the participant's omission. The participants filled out an informed consent and completed the Demographic and Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) [30]. According to the PAR-Q+, older adults with a high-risk level who did not participate had severe diseases or consumed many medications. Participants were randomly divided into four groups according to age and BMI (n=10): yoga, supplement, training and supplementation, and control groups. The participants' blood lipids were measured before and after the test, and their weight was also measured.

The experiment protocol of yoga exercise with weights was started 24 hours after the initial blood sampling (pretest phase) and performed for eight weeks [31]. The first four weeks consisted of two sessions per week, and the second four weeks consisted of three sessions per week. Each training session was based on full-body movements, starting with a warm-up and ending with a cool-down. Therefore, a combination of standing, balancing, sitting, and lying movements was included in each session, and at least six to eight movements were performed. However, the load intensity gradually increased due to time constraints, and the sessions started from 40 minutes and progressively reached 75 minutes in the final weeks. The actions were adjusted according to the principles and rules of yoga, physical fitness, and the principles of gradual overload. As initial sessions focused on structural adaptation and correct movement training, the exercise was started with 450g dumbbells and gradually increased the overload [32]. Consuming groups of Spirulina supplement, a knowledge-based product (Persian Gulf Algae Technology

Development), consumed three capsules (500g) daily for eight weeks [33].

The control group participants had no exercise intervention, and the volunteers continued their usual lifestyle. The exercise and placebo groups received the identical placebo capsules as the Spirulina capsules filled with starch and the same daily dose [34].

Each subject took a 5cc blood sample in two pretest and posttest stages after 12 hours of fasting between seven and nine in the morning. Post-test sampling was done 48 hours after the last training session. Lipid profile parameters, including triglyceride (sensitivity 1mg/dL), total cholesterol (sensitivity 2mg/dL), HDL (sensitivity 1mg/dL), and LDL (sensitivity 1mg/dL) were measured using enzymatic calorimetry method (Pars Azmoun kits, Iran).

The mean and standard deviation of the data were calculated in descriptive statistics. The Shapiro-Wilk test was used to check the normality, and a T-test was used to compare groups based on the significance level. A one-way analysis of covariance (ANCOVA) test was performed to compare between groups. Finally, an LSD post hoc test was also used to determine which group had more effects. All statistical analyses were performed using the SPSS statistical software (version 22) (significant level is $\alpha \leq 0.05$).

Table 1. Demographic data

		Control	Exercise	Supplement	Exercise + Supplement
Age (Year)		62.22 ± 2.13	62.02 ± 2.70	63.50 ± 2.48	61.64 ± 2.88
BMI (kg/m²)	**Pretest**	29.24 ± 1.34	29.25 ± 0.94	29.21 ± 0.87	29.82 ± 1.16
	Posttest	29.37 ± 0.99	28.18 ± 0.96	29.21 ± 0.90	27.65 ± 0.98

Table 2. Descriptive and analytical measurements data

variables	group	The mean and standard deviation		Intragroup significance level	Intergroup significance level
		Pre-test	Post-test		
HDL	**exercise**	40.96 ± 2.75	44.42 ± 2.71	0.04	0.0001
	supplement	39.53 ± 3.05	39.51 ± 2.00	0.99	
	exercise/supplement	42.04 ± 3.42	48.88 ± 2.73	0.001	
	control	40.11 ± 3.22	39.40 ± 1.47	0.54	
LDL	**exercise**	45.06 ± 3.71	40.52 ± 3.97	0.004	0.0001
	supplement	43.72 ± 2.38	43.12 ± 3.30	0.65	
	exercise/supplement	44.35 ± 3.14	35.07 ± 3.08	0.0001	
	control	43.51 ± 2.03	44.06 ± 3.01	0.58	
TC	**exercise**	225.06 ± 5.36	215.62 ± 7.83	0.01	0.0001
	supplement	219.61 ± 9.35	218.31 ± 11.97	0.74	
	exercise/supplement	225.53 ±11.17	200.43 ± 9.85	0.0001	
	control	222.79 ± 8.75	220.06 ± 11.05	0.41	
TG	**exercise**	159.03 ± 9.49	152.26 ± 9.16	0.03	0.0001
	supplement	160.32 ± 5.04	158.76 ± 6.65	0.40	
	exercise/supplement	157.29 ± 6.97	139.10 ± 9.52	0.0001	
	control	157.86 ± 8.25	158.68 ± 9.63	0.82	

Results

Participants were randomly divided into four groups (n=10). Table 1 shows the participants' ages and BMI in the pre- and post-test. No significant difference is detected in groups or between pre- and post-test data in Table 2.

The independent variable was the type of exercise, and the dependent variables consisted of low-density lipoprotein, high-density lipoprotein, triglyceride, and total cholesterol levels after exercise. Therefore, the LDL, HDL, TG, and TC levels of the participants before the intervention (exercises) were used as covariates in this analysis. Therefore, preliminary investigations were conducted to ensure that the assumptions of normality, linearity, variances, and regression slope homogeneity were not violated. The amount of changes in HDL level between groups after taking measurements and exercises were ($F= 36.02$), ($p<0.0001$), ($Es=0.76$), LDL level with ($F=16.47$), ($p<0.0001$), ($Es=0.5$), TC level with ($F=10.22$), ($p<0.0001$), ($Es=0.46$) and the TG values ($F=12.20$), ($p<0.0001$), ($Es=0.51$) showed a significant difference.

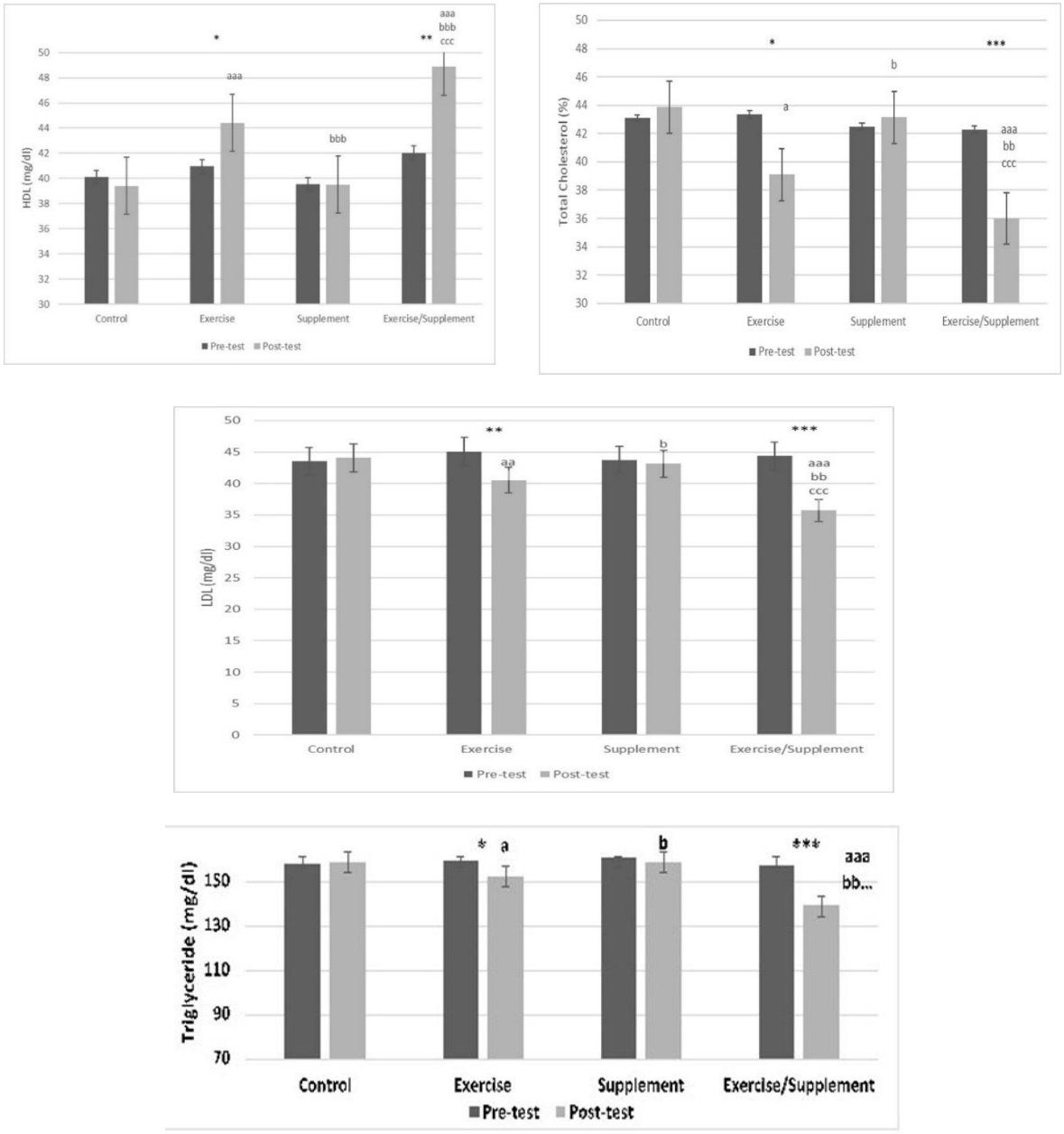

Figure1. The effect of 8 weeks of yoga practice with weight along with Spirulina supplement on Total Cholesterol, TG (triglyceride), HDL (high density lipoprotein), and LDL (low-density lipoprotein) Values before and after the examination

* Significant difference between pre and post-test groups (P≤0.05)
* *Significant difference between pre and post-test groups (P≤0.001)
*** Significant difference between pre and post-test groups (P≤0.0001)
a significant difference with control group (P≤0.05)
aa significant difference with control group (P≤0.001)
aaa significant difference with control group (P≤0.0001)
b significant difference with exercise group (P≤0.05)
bb significant difference with exercise group (P≤0.001)
bbb significant difference with exercise group (P≤0.0001)
c significant difference with supplement group (P≤0.05)
cc significant difference with supplement group (P≤0.001)
ccc significant difference with supplement group (P≤0.0001)

In the final evaluation of the LSD post hoc test and the inter-group comparison of post-test groups, the HDL variable increased significantly. The LDL, cholesterol, and triglyceride groups decreased significantly in exercise and exercise/supplement compared to the control group. In other words, consuming Spirulina supplement with exercise alone causes a significant increase in HDL concentration. Spirulina supplementation with exercise significantly reduced LDL, cholesterol, and triglycerides.

Discussion

The benefits of using Spirulina supplement and exercise showed that Spirulina supplement and exercise alone affected the lipid profile, while Spirulina alone could not be helpful. On the other hand, LDL, Triglyceride, and total cholesterol decreased significantly in the exercise and exercise/supplement groups, while HDL increased. Spirulina supplements and exercise significantly increased HDL compared to exercise, but their simultaneous benefit on other factors was not significant.

Different studies have shown that Spirulina can manage metabolic syndrome and reduce the risk of cardiovascular events. Spirulina supplementation in healthy elderly significantly reduced plasma triglyceride, total cholesterol, and LDL as a helpful food for older adults [27]. In another study, plasma levels of triglyceride, total cholesterol, and LDL were significantly reduced in older adults after Spirulina supplementation for 24 weeks [35], or consumption of Spirulina supplements in type 2 diabetic patients led to a significant reduction in the concentration of triglycerides, total cholesterol, and LDL in plasma [36]. Although various studies have shown the benefits of Spirulina supplementation on lipid profile [37, 38], the researchers believe that the optimal dose, the optimal dose, and duration of use are controversial and require future research. This uncertainty can justify the lack of Spirulina effectiveness in the present study and can be considered one of this study's limitations.

In one study, a systematic physical exercise program and Spirulina supplementation reduced the BMI and blood lipid profile (TC, TAG, and LDL-C) of obese dyslipidemic men [39]. Hernández et al. demonstrated that Spirulina Maxima supplementation can act synergistically with exercise due to its enhanced effects on body composition and blood lipid profile in diabetic Wistar rats [14]. Another study on mice stated that Spirulina alone or exercise in diabetic mice significantly reduces total LDL, cholesterol, and liver fats [40]. The results of all these articles were consistent with those of the present research. However, the use of yoga can make the present study more practical because yoga is a complementary therapy that helps prevent and treat certain medical conditions despite the benefits of yoga exercise in controlling balance, managing pain, and preventing falls in older adults [41, 42]. Yoga effectively treats cardiometabolic risk factors, such as blood pressure, lipid levels, glucose levels, and body weight, by improving physiological stress [43]. A study reported a better lipid profile in long and medium-term meditators when compared to non-meditators [44]. Despite these claims, some evidence shows that high-intensity yoga has no significant effects on cardiovascular outcomes or blood parameters [45]. Therefore, yoga interventions significantly affected lipid profiles. However, more qualified trials or cohort studies are needed to conclude precisely [46].

Conclusions

Based on the results, yoga practice with weights had good metabolic effects, especially with the supplement. One strength of current research was the significant reduction of cholesterol and triglycerides following yoga exercises with weights, which was more effective than the Spirulina supplement. Thus, finding the best dose and the best period of administration is debated, and future investigation is required.

Declarations

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Declaration of Competing Interest
No conflict of interest can be declared.

Data Availability
Data would be available by emailing the authors.

Authors' Contribution
S.Sh., as the thesis supervisor, did the project administration. M.B. did the investigation and the software analysis; R.R. advised the project methodology. M.B. wrote the paper draft, and other authors reviewed it. All authors read and approved the final version of the manuscript.

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