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Original Article

Comparison of the effects of flaxseed oil and sunflower seed oil consumption on serum glucose, lipid profile, blood pressure, and lipid peroxidation in patients with metabolic syndrome

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KEYWORDS:
Flaxseed oil;
Sunflower seed oil;
Metabolic syndrome;
Lipid peroxidation;
Blood pressure

BACKGROUND: Metabolic syndrome (MetSyn) increases the risk of type II diabetes and morbidity and mortality due to cardiovascular diseases. Flaxseed oil (FO), as a functional food, is one of the major vegetal sources of essential omega-3 fatty acids.

OBJECTIVE: This study aimed to compare the effects of consumption of FO and sunflower seed oil (SO) on lipid peroxidation and other symptoms of MetSyn.

METHODS: This randomized controlled interventional trial was conducted on 60 volunteers aged 30 to 60 years who were diagnosed with MetSyn in Shiraz, Iran. The participants who fulfilled the inclusion criteria were randomly assigned to SO (n = 30, receiving 25 mL/d SO) and FO (n = 30, receiving 25 ml/d FO) groups using block randomization. The diets were identical for all the participants. Blood pressure (BP), serum lipid, fasting blood sugar, and malondialdehyde were measured at baseline and at the end of week 7.

RESULT: The results showed no significant difference between the 2 groups regarding blood lipid levels and fasting blood sugar at the end of the study. However, significant reductions in total cholesterol, low-density lipoprotein cholesterol (5.6% in FO and 10.8% in SO), and triglyceride levels were seen within each group after treatment with FO and SO ($P < .05$). Nonetheless, between-group changes were significant (<0.05) for systolic BP (mean [±standard deviation {SD}] changes were −14.0 ± 22.41 in the FO group [$P = .004$] and 0.92 ± 8.70 in the SO group [$P = .594$]) and diastolic BP (mean [±SD] changes were −4.26 ± 7.44 in the FO group [$P = .007$] and 1.30 ± 6.91 in the SO group [$P = .344$]), but marginally significant ($P = .053$) for malondialdehyde level (mean [±SD] changes were −1.29 ± 1.48 in the FO group [$P < .001$] and −0.52 ± 1.34 in the SO group [$P = .52$]). A significant decrease in weight was also found in both groups. However, waist circumference decreased significantly only in the FO group at the end of the study ($P < .05$).

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CONCLUSION: Our results indicated that dietary FO could be effective in amelioration of some symptoms of MetSyn and decrease BP and lipid peroxidation.
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Introduction

Metabolic syndrome (MetSyn) represents a collection of disorders, such as insulin resistance, dyslipidemia, hypertension, and abdominal obesity, and is related to an increased risk of type II diabetes and morbidity and mortality due to cardiovascular diseases (CVDs).[1,2] This syndrome is a common global metabolic disorder and overlaps with other conditions, such as nonalcoholic fatty liver disease and microvascular disease that is one of the major public health and worldwide medical problems.[3] According to the results of the Finnish Diabetes Prevention Study and the US Diabetes Prevention Program, the main treatment for MetSyn was lifestyle change including physical activity and nutrition.[1,4]

Functional foods with positive effects on health are good choices for reducing the risk of chronic diseases.[5,6] Flaxseed, as a functional food, is one of the major vegetal sources of essential omega-3 (n-3) fatty acids. Flaxseed contains 36% to 40% oil, with alpha-linolenic acid (ALA) being its major ingredient (57%).[5] Some prospective and cross-sectional studies showed that ALA could reduce the risk of MetSyn and CVDs.[6,7] Moreover, ALA competes with linoleic acid (LA) in their common metabolism pathways for producing their long-chain metabolites. LA converts to arachidonic acid (AA) in the desaturation-elongation pathway.[8] Involvement of AA in cell signaling triggers inflammation in some tissues, which results in more severe reactions compared to n-3 fatty acids.[5] Therefore, decreased production of AA and consequently decreased appearance of this fatty acid in tissues has been suggested to decrease proinflammatory eicosanoid, which may decrease inflammation in persons with MetSyn.[9] On the other hand, n-3 unsaturated fatty acids improve serum lipid metabolism, insulin resistance, hypertension, and dyslipidemia.[5,7] Besides, antioxidant activity of flaxseed oil (FO) reduces oxidation of low-density lipoprotein cholesterol (LDL-C), while elevation of oxidized LDL-C in MetSyn plays a role in atherogenesis development.[10]

Lignin is one of the phytoestrogen family substances, which has been considered to be an interesting component in plants. Secoisolariciresinol diglucoside is a precursor of lignin in mammalian body and flaxseed is the richest source of secoisolariciresinol diglucoside.[6] Lignin may exist in FO depending on the method of oil extraction.[11] Some oils contribute to higher polyunsaturated fatty acid (PUFA) intake including soybean and canola oils; however, sunflower seed oil (SO), which contains about 67% n-6 fatty acids (linoleic acid), is one of the most consumed sources of polyunsaturated fatty acids in the world. It also contains a considerable amount of vitamin E (alpha-tocopherol 690 ppm). Nevertheless, the impact of its regular consumption on MetSyn parameters is not clear yet.[12,13] Regarding the beneficial effects of the potential components of FO on different components of MetSyn, the present study aimed to assess the effect of FO consumption on selected MetSyn symptoms in patients suffering from MetSyn.

Materials and methods

Study population

The participants were 30 to 60 years old and were diagnosed with MetSyn. MetSyn was assessed according to the National Cholesterol Education Program's Adult Treatment Panel III report criteria. Accordingly, MetSyn was confirmed by the presence of 3 or more of the following criteria[14]: waist circumference (WC) ≥102 cm or 40 inches for men and ≥88 cm or 35 inches for women, fasting blood sugar ≥110 mg/dL, high-density lipoprotein cholesterol <40 mg/dL for men and <50 mg/dL for women, fasting triglyceride (TG) level ≥150 mg/dL, and systolic blood pressure (SBP) ≥130 mm Hg or diastolic blood pressure (DBP) ≥85 mm Hg.

The participants were recruited from a screening program in Shiraz Healthy Heart Institute during April 2015 and July 2015. Written informed consents were obtained from all the participants before the study. Suffering from any chronic inflammatory diseases, infection, diabetes mellitus, uncontrolled hypertension, cancer, autoimmune diseases, and kidney and liver diseases, taking antihypertensive, lipid- or glucose-lowering medications or lipid-modifying agents (e.g., statins, fibrates, and so forth), using any dietary supplements containing omega-3 fatty acids (during the past 3 months), being under treatment with aspirin, propranolol, nonsteroidal anti-inflammatory drugs, and any form of steroids, consuming alcohol, smoking, simultaneously participating in other interventional studies, being on any therapeutic diet–restricted or calorie-restricted regimen, having positive history of angioplasty, heart attack, and any kind of major surgeries within 6 months before the beginning of the study, being pregnant, lactating, and being uncomfortable with oil consumption were the exclusion criteria of the study. In case the patients started taking the aforementioned medications during the study, they were excluded. The volunteers were instructed to continue any other medications unchanged and to maintain their normal level of physical activity throughout the study.

Study design

In this randomized controlled clinical trial, 60 of the 145 patients who had been referred to the Shiraz Healthy Heart

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