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Original article

Short-term effects of Mediterranean-type diet intervention on soluble cellular adhesion molecules in subjects with abdominal obesity

Loukianos S. Rallidis [a], Anastasia Kolomvotsou [b], John Lekakis [a], Paul Farajian [b], Georgia Vamvakou [a], Nikolaos Dagres [a], Maria Zolindaki [c], Stamatis Efstathiou [d], Maria Anastasiou-Nana [a], Antonis Zampelas [b, *]

[a] Second Department of Cardiology, Attikon Hospital, School of Medicine, University of Athens, Greece
[b] Unit of Human Nutrition, Department of Food Science and Human Nutrition, Agricultural University of Athens, Greece
[c] Biochemistry Laboratory, General Hospital of Nikea, Piraeus, Greece
[d] Hygeias Melathron Infirmary, Athens, Greece

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SUMMARY

Background & aims: Abdominal obesity (AO) is associated with increased risk for cardiovascular disease and with increased production of adhesion molecules. The present work examined the effect of a Mediterranean-style diet on soluble cellular adhesion molecules in individuals with AO.

Methods: Ninety subjects with AO without cardiovascular disease or diabetes mellitus were randomly allocated to the intervention or control group and were instructed to follow a Mediterranean-style diet for two months. Intervention group followed a specific relevant food plan with close dietetic supervision and provision of basic foods. Soluble intercellular adhesion molecule-1 (sICAM-1), soluble vascular cell adhesion molecule-1 (sVCAM-1), sP and sE-selectin, C-reactive protein (CRP) and interleukin-6 (IL-6) were measured.

Results: Subjects in the intervention group increased their intake of total fat, monounsaturated fatty acids, dietary fiber, vitamin C, and alcohol compared to controls, while decreased their intake of saturated fat. Although there was a significant decrease in CRP, sP-selectin and in sE-selectin in the intervention group, and an increase in sVCAM-1 in the control group, between-group analysis showed no statistically significant differences. There were also no significant changes in sICAM-1, and IL-6 levels after intervention.

Conclusions: Mediterranean-type diet for two months combined with close dietetic supervision showed a beneficial tendency towards the down-regulation of some markers of vascular inflammation, although the comparison between groups after the intervention did not reach statistical significance. A longer period of dietary intervention may be required to further support these changes.

1. Introduction

Recent estimates indicate that abdominal obesity (AO) is highly prevalent ranging from 40 to 60% in the general population [1]. There is mounting evidence that AO is associated with increased risk for cardiovascular disease (CVD) and diabetes mellitus [1–3], while is also considered as the obesity phenotype most likely to be associated with insulin resistance, endothelial dysfunction, lipid disorders, increased inflammatory burden and coagulation abnormalities [4,5].

Inflammatory response plays a central role in all phases of the atherosclerotic process [6,7]. Leukocyte adhesion to vascular endothelium and subsequent transendothelial migration from the blood to the arterial intima is a critical pathogenic component in the initiation and progression of atherosclerotic lesions. This process is predominantly mediated by cellular adhesion molecules (CAMs), which are expressed on the endothelial membrane in response to several inflammatory stimuli [8,9]. Among CAMs the selectins (P, E and L selectin) facilitate the tethering and rolling of leukocytes along vascular endothelium while the intercellular adhesion molecule-1 (ICAM-1) and vascular cell adhesion molecule-1 (VCAM-1) mediate the firm adhesion of leukocytes to endothelium [8,9].

* Corresponding author. Iera Odos 75, Athens, 11855, Greece. Fax: +30 2105294945.
E-mail address: azampelas@aua.gr (A. Zampelas).

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Abbreviations

AO	abdominal obesity
BMI	body mass index
CAMs	cellular adhesion molecules
CRP	C-reactive protein
CVD	cardiovascular disease
IL-6	interleukin-6
MUFAs	monounsaturated fatty acids
PUFAs	polyunsaturated fatty acids
SFA	saturated fatty acids
sICAM-1	soluble intercellular adhesion molecule-1
sVCAM-1	soluble vascular cell adhesion molecule-1

Several epidemiologic and intervention studies have shown that Mediterranean diet is associated with lower incidence and lower mortality of CVD [10,11]. Micro- and macronutrients components of the Mediterranean diet interact in a synergistic way to exert an anti-atherogenic effect. In vitro studies have shown that basic components of Mediterranean diet such as olive oil and red wine polyphenols, inhibit the expression of CAMs in human umbilical vascular cells [12,13]. However, clinical studies have yielded contradictory results regarding the effect of Mediterranean diet on soluble forms of CAMs (sCAMs) [14–18].

In dietary intervention trials compliance has been a major problem. It has been shown that intensive education on the Mediterranean diet, close dietetic supervision, or group educational sessions coupled with free provision of Mediterranean-related dietary products improve adherence to diet and enhance its beneficial effects [19,20]. Moreover, the effect of Mediterranean diet on sCAM in subjects with AO has not been investigated. Therefore, the aim of this study was to assess the effect of a Mediterranean diet combined with close dietetic supervision on sCAMs in subjects with AO.

2. Materials and methods

2.1. Subjects

Ninety subjects with AO (waist circumference >102 cm for men and >88 cm for women) were recruited from the outpatient Cardiology Department of the University Attikon Hospital and Hygeias Melathron Infirmary in Athens, selected from a pool of 340 subjects who were employees in a National Bank who had been referred for their annual check-up. Exclusion criteria were: presence of diabetes mellitus or CVD, age above 70 years, use of multivitamins, and presence of malignancy or any disease state that might influence inflammatory markers. More specifically, patients with impaired glucose tolerance were not excluded, since no oral glucose tolerance test was performed. Impaired fasting glucose patients (according to the WHO criterion [110–125 mg/dl] or the ADA criterion [100–125 mg/dl]) were not excluded either. However, we did not include diabetics, in as much as diabetes is associated with a more advanced inflammatory state, and, subsequently, with increased levels of soluble adhesion molecules [21,22]. Furthermore, during the previous 6 months participants should not have taken part in any weight reduction program, other nutritional interventions, or have practiced regular extreme physical activity (>6 h of vigorous exercise per week). This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Agricultural University research committee. Written informed consent was obtained from all subjects.

2.2. Study design

On enrolment participants were assigned to the intervention (n = 46) or the control group (n = 44) using a sequence of random binary numbers (i.e. 001110110 where 0 represented the intervention group and 1 the control group). At their first appointment with the dietitian, all participants were informed about the study, asked to keep a 3-days food diary, and completed a basic questionnaire to determine age, socioeconomic status, medical history, family history, physical activity, smoking and alcohol consumption habits. All participants were provided with a copy of the Greek Mediterranean diet and were counselled on this type of eating pattern.

The intervention group received more counselling on food groups and specific items, frequency and portion size of each food group to be consumed and were asked to follow a specific daily and weekly food plan. The food plan included the daily consumption of whole wheat grains and products, 2–3 portions of low-fat dairy products, 2 salads (one of which should contain at least 1 tomato) and at least 3 fruit together with a 100 ml concentrated fruit juice made without preservatives and high concentration of antioxidant nutrients [mainly vitamin C (30 mg per 100 ml); provided by ELAIS-Unilever Hellas SA] and fiber (1,5 g per 100 ml), 5 ml (i.e. one teaspoon) of olive oil-based margarine [containing 35 g of fat and 12 g of monounsaturated fatty acids (MUFAs) per 100 g of product; provided by ELAIS-Unilever Hellas SA], extra virgin olive oil as the main source of fat (provided by ELAIS-Unilever Hellas SA), 45 ml (i.e. 3 tablespoons) of extra virgin olive oil with one of the 2 salads, 6 whole raw almonds, and 150 ml (1 wine glass) of red wine (provided by Harlaftis Ltd, Greece) with their main meal. According to the food plan, the intervention group was required to consume at least one portion of fish, and not to exceed the consumption of one portion of red meat weekly. Dietary plans were designed to improve the diet quality of the subjects according to the Mediterranean diet scheme and to meet their daily energy requirements. Subjects were not instructed or guided to reduce their body weight (both intervention and control groups). The intervention group was closely supervised by a dietitian who made weekly phone-calls and attended weekly appointments with participants. During these sessions body weight was measured and participants handed in their 3-days food diary (every second session), completed a 24-h recall, and returned the packets of the products they had received previously along with the food plan check lists, in order to assess indirectly the compliance. The dietitian should weigh them and calculate the amount consumed and compare it with the amount that was expected to be consumed. It is noteworthy to remark that all the packets used by the volunteers were returned empty. The objective of the 24-h recall was to check subjects' compliance and to reinforce the key principles of the Mediterranean diet. The 3-days food diaries were used to measure dietary intake at both the beginning and the end of the study. Subjects in the control group met with the dietitian only at the beginning and the end of the study.

The duration of the dietary intervention was two months for both groups. Height, body weight and waist circumference were measured for all participants at the beginning and at the end of the study. Body mass index (BMI) was calculated by dividing the participants' weight by their height squared (kg/m^2).

2.3. Energy and nutrient intake

Both groups kept food diaries for three days at the beginning and at the end of the study. The analysis of the food diaries was

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