Mediterranean Diet and Health: Is all the Secret in Olive Oil?

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Key Words

Olive oil · Mediterranean diet · Food consumption ·
Nutrient intake · Dietary guidelines · Thrombosis

Abstract

Objective: The purpose of this study was to review and analyze the synergies of olive oil related food consumption and nutrient intake in a Mediterranean region.

Design: Cross sectional study by face to face interview.

Setting: Population based random sample derived from the Catalan Nutrition Survey.

Subjects: 1600 individuals between 18 and 60 years of age.

Intervention: Two 24-hour recalls were administered to measure food and nutrient intakes. Food group consumption and nutrient intakes ratios between the highest (greater than 13.5% of total calories, 4th quartile) and lowest quartiles (less than 6.8% of total calories, 1st quartile) of olive oil consumption were calculated.

Results: Comparing the highest quartile of olive oil consumption to the lowest, the highest ratios by food group consumption were observed for eggs, vegetables and fish in both men and women and non fried potatoes in women only. Lower ratios were associated

in both sexes with softdrinks, commercially baked goods, processed meat and full fat milk and nuts in women only, and fried potatoes in men only. Analysis by nutrients showed higher ratios for carotenoids, monounsaturated fatty acids, vitamin E and folic acid in both sexes and Vitamin C and polyunsaturated fatty acids in women only. Lower ratios were seen for mono, di and polysaccharides, saturated fat, retinol and sodium in both genders and calcium niacin, thiamin, riboflavin and fibre in men only.

Conclusion: Olive oil is a key contributor to the healthy aspects attributed to the Mediterranean diet, since its own health attributes may be added to those of foods that it's commonly served with (fish, vegetables), thus contributing to its thrombosis related disease preventive properties. As such, nutritional objectives in Mediterranean countries should address reducing saturated fats, without modifying quantities of olive oil, and increasing fish, vegetables and nuts.

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Introduction

The countries bordering the Mediterranean Sea are characterized by dietary habits, lifestyles and cultural contexts associated with optimal health and quality of life. The well

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1424-8832/04/0336-0461\$21.0/0

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known triad of wheat, olives and grapes and their derivatives (bread, pasta, couscous), olive oil and wine along with foods such as fruits and vegetables, fish, meat (in reduced quantities), dairy products (yogurt and cheese), pulses and nuts comprise the basis of Mediterranean food patterns. In acknowledgment of the region's diverse patterns based on existing cultural and religious differences, currently the term Mediterranean diets has more often been employed [1].

A key element common to all these diets is olive oil, whose health benefits have been demonstrated in the past few decades. Olive oil's vital components, monounsaturated fatty acids (MUFA) and antioxidant and anti-thrombotic substances are attributed with its protective effects against, among others, arteriosclerosis, cardiovascular disease, certain cancers and age related cognitive decline [2]. It is also a rich source of monounsaturated oleic acid (comprising between 55 to 85% of fatty acid content) and antioxidants such as vitamin E and a variety of phenolic compounds [3].

Apart from MUFA's well recognized beneficial effects on LDL and HDL cholesterol profiles, it may also play a role in reducing the thrombogenic-atherogenic process by various actions on arterial thrombus formation (such as decreased monocyte adhesion, increased fibrinolysis, decreased arterial pressure and insulin). Additionally the antioxidant substances found in olive oil (vitamin E and diverse phenolic compounds: hydroxytyrosol, tyrosol, oleuropein and verbacosid, among others) could influence atherogenesis. Specifically, phenols key actions include: 1) inhibition of LDL-cholesterol oxidation, 2) protection against free radicals and their toxic effects, 3) inhibition of platelet aggregation and thromboxane generation, 4) stimulation of anti-inflammatory agents, and 5) increased nitric oxide production. Phenolic compounds are mainly found in extra virgin olive oil, and their concentration varies according to geographical location and processing methods [4].

The purpose of this study was to conduct an in depth analysis of advantages inherent to olive oil consumption with respect to the Mediterranean diet and the prevention of thrombosis related diseases, as well as evaluate food consumption patterns and energy and nutrient intakes ratios related to the relative contribution of olive oil.

Material and Methods

The present analysis was conducted drawing from the database of the Catalan Nutritional Survey (1992-93); the methodology of this survey has been described elsewhere [5,6] and will be summarized here. The random sample population consisted of inhabitants aged 6 to 75 living in Catalan municipalities.

Dietary assessment consisted of combining two 24-hour

recalls and a food frequency questionnaire with 77 food items. The 24-hour recall was carried out twice during the 1992 study period, the first in a warm season (May-July) and the second in a cold season (November-December). This was to avoid the influence of seasonal variations. The surveys were always carried out at the home of the subject being interviewed. There were 36 interviewers, assigned an average of 78 subjects each, which allowed the fieldwork to be completed within the 6 week timeframe anticipated for this phase of the project. The interviewers, who were all dietitians, underwent a rigorous selection process and training program, thus establishing a quality control mechanism which lasted throughout the entire dietary data collection period. Twenty percent of the sample was interviewed by phone in order to verify some aspects of the dietary information previously gathered by personal interview. The coding of food data was carried out by the same interviewers, under the supervision of two dietitians.

In order to estimate volumes and portion sizes, the household measures found in the subjects' own homes were used. Volumes for these measures were also noted concurrently. On some occasions standard portions sizes were used. Diet histories for subjects with disabilities or memory defects were carried out via the primary caretaker. Conversion of food into nutrients was made utilizing the French "Répertoire générale des aliments" which comprised of 572 foods specifying 32 nutrients and energy [7]. Adjustment for intra-individual variability was conducted by analysis of variance, using the method described by Beaton and Liu [8].

For the present analysis the population aged 18 to 60 was distributed according to their quartile of olive oil consumption, using adjusted values for intra-individual variability. The consumption of principal food groups ratios between high and low consumers (4th and first quartile) of olive oil are presented graphically. Ratios also included the intake of energy, vitamins and minerals. Ratios were always standardized by age using the indirect method.

Out of a total of 4,000 individuals included in the random sample, 2,757 (68.9%) participated in the survey, and those participants aged 18 to 60 years (1,600) were selected.

Results

Comparing the highest quartile of olive oil consumption to the lowest, the highest ratios by food group consumption were observed in both genders for eggs (2.21 & 2.04 in women and men, respectively, $p<0.001$), vegetables (2.20 & 1.86 in women and men, respectively, $p<0.001$), and fish (1.38 & 1.47 in women and men, respectively, $p<0.01$) and non fried potatoes (1.17, $p<0.05$) in women only. Lower

Fig. 1. Food group consumption ratio between the highest (Q4) and the lowest (Q1) quartile of percentage of energy from olive oil in Catalonia Spain

ratios were associated in both sexes with softdrinks (0.42 & 0.44 in women and men, respectively, $p<0.001$), commercially baked goods (0.56. & 0.39 in women and men, respectively, $p<0.001$), processed meat (0.66, $p<0.01$ in women & 0.68, $p<0.001$ in men) and full fat milk (0.68 & 0.57 in women and men, respectively, $p<0.001$), with associations for nuts (0.38, $p<0.01$) seen only in women and fried potatoes (0.57, $p<0.01$) only in men (figure 1).

Analysis by nutrients showed higher ratios for carotenoids (1.56 & 1.5 in women and men, respectively, $p<0.001$), monounsaturated fatty acids (1.32, $p<0.001$ in women & 1.12, $p<0.01$ in men), vitamin E (1.25 & 1.14 in women and men, respectively, $p<0.001$) and folic acid (1.25, $p<0.001$ in women & 1.10, $p<0.01$ in men) in both sexes and Vitamin C (1.25, $p<0.001$) and polyunsaturated fatty acids (1.18, $p<0.001$) in women only. Lower ratios were seen for mono and disaccharides (0.85 & 0.70 in women and men, respectively, $p<0.001$), polysaccharides

Fig. 2. Daily energy and nutrient intake ratio between the highest (Q4) and the lowest (Q1) quartile of percentage of energy from olive oil in Catalonia, Spain

(0.86, $p<0.01$ in women, 0.76, $p<0.001$ in men), saturated fat (0.91, $p<0.05$ in women, 0.84, $p<0.001$ in men), retinol (0.82, $p<0.01$ in women, 0.92, $p<0.05$ in men) and sodium (0.88, $p<0.01$ in women, 0.77, $p<0.001$ in men) in both genders and calcium (0.79, $p<0.001$) niacin (0.79, $p<0.001$), thiamin (0.84, $p<0.001$) riboflavin (0.83, $p<0.001$) and fibre (0.88, $p<0.01$) in men only (figure 2).

Discussion

In the Mediterranean region, olive oil has traditionally been consumed in elevated quantities, which has led to high values of dietary fat as a percentage of total calories, ranging from 25 to 40% or more, depending on the country. This fact has conflicted with nutritional objectives in Western countries that limit total fat intake to less than 30% or even 20% of calories. This goal would be completely unattainable

in Mediterranean countries without a drastic reduction in olive oil consumption.

Nutritional objectives have been formulated from different positions: 1) for the appropriateness of reducing total dietary fat in the more classic academic circles [9], or 2) for improving the quality of fat consumed, principally through the incorporation of olive or other oils rich in monounsaturated fatty acids. The latter approach is common in Mediterranean countries and among certain more innovative academic forums [10,11].

In the present analysis, the effect of the presence of olive oil in varying quantities in the Spanish diet on food and nutrient intakes was further investigated via a cross-sectional study. It was conducted in a large representative sample of the Catalan population, whose methodology and results have previously been described [5,6].

A previous analysis demonstrated that individuals consuming greater quantities of olive oil (upper quartile) had higher total fat intakes (around 42% of total calories) than those who consumed less olive oil (36% of total calories from fat). However, the percentage of total calories derived from saturated fats was lower in those persons with higher olive oil consumption, especially in women (12.5 versus 13.5%) [6]. Individuals with diets higher in dietary fat and olive oil presented significantly more favorable food profiles that are in keeping with Mediterranean diet patterns, such as greater consumption of fish, eggs, vegetables and added fats/oils. In contrast, those with lower total dietary fat intakes and more restricted olive oil consumption had higher intakes of cereals, baked goods, full fat milk, sausages, candy, fruit juice and soft drinks. Therefore, a significant part of the differences in monounsaturated fatty acid intakes observed in high and low olive oil consumers was the substitution of olive oil for mono and disaccharides. Full fat dairy products and sausages in the group with low olive oil consumption accounted for the concomitant greater intakes of saturated fats [6].

Despite the fact that the Mediterranean diet concept has gained popularity within the scientific community and population at large, there is no single Mediterranean diet but rather there are as many Mediterranean eating patterns as there are Mediterranean countries. Furthermore, in addition to defining the characteristic food habits, it's important to recognise that not all countries bordering the Mediterranean have preserved the distinctive dietary patterns that were defined and reappraised by Professor Ancel Keys in the 1950s [12]. Changes that have occurred in the Mediterranean diet include reduced calorie intake and expenditure, increased consumption of low nutrient dense foods (soft drinks, candy, sweets, etc.) as well as food processing techniques (i.e. refining of flour and changing feeding animal practices). These factors have impacted upon

certain nutritional benefits characteristic of the diet (reduced antioxidant and vitamin intake, increased proportions of saturated fatty acids, decreased fibre consumption, etc.), and reflect changes in cultural values and lifestyles in the Mediterranean. As a result, the legacy the Mediterranean diet represents for the health of its inhabitants has been compromised [13].

Ischemic heart disease (IHD) is multifactorial with a complex etiology. Conventional risk factors including serum lipids account for less than one half of future IHD events. In the past few years, novel risk factors such as hemostatic and thrombotic factors contributing to the development and progression of IHD have been explored. Typically, diet is the first line of consideration in the prevention of IHD, but very little is known about the effect of diet and nutrients on hemostasis and thrombosis, except for the effect of omega-3 fatty acids. Cross-sectional studies indicate that vegetarians may have a lower concentration of certain markers of hemostasis compared with nonvegetarians. Platelet aggregation, an index of thrombosis, appears to be higher among vegetarians than nonvegetarians. Monounsaturated-fat-rich plant foods may have a protective role in hemostasis and may explain in part the lower incidence of IHD in Mediterranean countries with a diet high in olive oil. Finally, certain fruits and vegetables such as soy, garlic, and purple grapes may have anti-thrombotic effects, which may in part be due to the phytochemicals in these foods [14]. Obviously a sufficient amount of fish, particularly fatty fish (fatty fish represents 60% of the total amount of fish in a Mediterranean country like Spain) [15] will substantially increase the intake of omega-3 fatty acids and enhance anti-thrombotic effects of the diet.

The current western diet is very high in omega-6 fatty acids as a result of a high consumption of seed oils and the industrial production of animal fats [16,17]. In addition, cultivated plants have lower amounts of omega-3 than wild plants and herbs [18,19].

It is well established that the intake of eicosapentaenoic acid (EPA) and docosahexaenoic acid DHA from fish leads to: 1) decreased production of prostaglandin E metabolites, 2) decreased concentration of thromboxane A₂, 3) decreased formation of leukotriene B₄, 4) increased concentration of prostacyclin PGI₃, and 5) increased concentration in leukotriene B [16,17].

Thus, fish and other major sources of omega-3 (nuts and certain seeds) may contribute to the anti-thrombotic and anti-inflammatory effects of the Mediterranean Diet. In addition, since olive oil is the primary fat source in the Mediterranean diet (as seed oils fatty acids are in other western diets) the ratio of omega-6/omega-3 will be much more favourable in Mediterranean countries with high fish consumption, as is the case of Spain [20]. Spain is one of the

highest fish consumers in the world with an average of 80g/person/day.

In the present study we have observed that high olive oil consumers have greater intakes of fish than low olive oil consumers (with a difference of more than 40 g/day), mainly due to the fact that fish is usually fried in olive oil in Spain. However, higher olive oil consumers showed lower intakes of nuts, although the difference was relatively small (2 g/day) and not comparable with the contribution of higher fish consumption in magnitude. Vegetables are also consumed in greater amounts in the highest olive oil consumers, facilitating the synergism of some of their components, such as flavonoids or folates, in the homeostatic and anti-thrombotic activity of Mediterranean diets, even in diabetic patients [21,22]. Wine consumption and other alcoholic beverages were not included in the present analysis but may also have synergistic and antagonistic effects.

As a conclusion, olive oil is a crucial element of the Mediterranean Diet, not only for its inherent nutritional

effects but also the cumulative benefits of the foods that are typically prepared with olive oil (vegetables, fish). Some of these foods may contribute to the anti-thrombotic and anti-inflammatory effects of the Mediterranean Diet, as well as to its anti-oxidative properties. On the other hand, the heaviest olive oil consumers had lower intakes of cereals, baked goods, whole milk and sausages, which may constitute additional sources of omega-6.

Appropriate analyses of food consumption patterns may be a critical element to evaluate the theoretical synergic and antagonistic effects of food groups. Moreover, it is extremely useful in the planning and development of food based dietary guidelines and nutrition policies.

Acknowledgments

Sponsorship: Catalan Department of Health

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