

The Mediterranean diet and lifestyle

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Abstract

The Mediterranean Diet (MedDiet) is characterized by a high intake of fruit, vegetables, whole grains, legumes, and olive oil, moderate consumption of poultry and fish, and a limited intake of red meat and minimal processed foods. It has been associated with many health benefits, including the prevention and management of metabolic syndrome, diabetes, cardiovascular disease, neurodegenerative diseases, and certain types of cancer, as well as increased longevity and reduced risk of mortality. The protective effects of the MedDiet are related to its antioxidant and anti-inflammatory properties. The MedDiet is not only a health-promoting dietary pattern, but it is also environmentally sustainable, showing a negative correlation with greenhouse gas emissions, among other environmental indicators. In addition to the MedDiet, the Mediterranean lifestyle, which involves regular physical activity, adequate rest, and socializing during meals, has also been linked to beneficial health outcomes. Preventive strategies for noncommunicable diseases should focus on promoting the Mediterranean lifestyle and implementing early detection and prevention programs, at both individual and social levels.

Key words: Mediterranean diet, Mediterranean lifestyle, antioxidants, inflammation, health effects

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Introduction

Poor eating habits are one of the main disease health risk factors worldwide (1). Diet and eating habits, whether excessive or insufficient, have been linked to several non-communicable diseases, such as obesity, diabetes, cardiovascular disease, and some types of cancer, which are significant contributors to global morbidity and mortality (2). Nutrition and food-related issues are included in several health objectives that the World Health Organization has set for the year 2025 in terms of non-communicable diseases, such as a 30% reduction in world salt consumption or the slowdown of the epidemics of obesity and type 2 diabetes (2).

Population diet can be studied based on the nutrients or food it provides, or based on its eating pattern, which considers all the interactions between constituents in foods, as well as their synergic effects (3, 4). There are several healthy recognized and recommended dietary patterns. Thus, the vegetarian diet (5), the DASH diet (Dietary Approaches to Stop Hypertension) (6) and the Mediterranean Diet (MedDiet) (7, 8) are associated with benefits in the prevention and management of metabolic syndrome and type 2 diabetes. Among them, the MedDiet pattern attracts special attention since it has been associated with a protective effect against cardiovascular disease, and cardiovascular and non-cardiovascular mortality (9, 10).

MedDiet

The MedDiet refers to the traditional eating pattern in the olive tree-growing countries of the Mediterranean area (3). Unfortunately, the current Mediterranean pattern is influenced by other lifestyles, such as the Western dietary pattern. Consequently, the traditional MedDiet described in the 1960s has become a more specific dietary pattern in rural regions. Namely, there is a decline in the adherence to this eating pattern among Mediterranean countries, especially among the younger population (11, 12). Urbanization and the influence of Western dietary patterns, often characterized by high consumption of processed foods, refined sugars, saturated fats, and low intake of fruits and vegetables, has led to significant changes in lifestyle and dietary habits too. The increased exposure to western media, global food markets, and the influence of fast-food chains have contributed to the adoption of less healthy eating habits, leading to a decline in adherence to the traditional MedDiet (13, 14).

Although there are several definitions of the MedDiet, it is known as a diet rich in olive oil and plant foods: fruit, vegetables, legumes, whole grains, and nuts. It is characterized by moderate consumption of poultry and fish, while the contribution of red meat and processed meats is highly reduced (15). Other definitions also consider the macronutrient and micronutrient composition (16).

The MedDiet pyramid was proposed by the MedDiet Foundation in 2010 and it is still in force (11). At the base of the pyramid are the foods that should be preferred in the diet (fruit, vegetables, cereals – preferably whole grains – and olive oil) and consumed at each meal, daily. At the next level are nuts, seeds, olives, and spices or aromatic herbs,

including onion and garlic, which should be consumed daily, but not with each meal. Below are foods recommended for weekly consumption, including white meat, eggs, fish, shellfish, and legumes. At the top of the pyramid are occasionally recommended foods such as potatoes, red meat, processed meats, and sweets. The MedDiet pyramid also recommends hydration with water and herbal infusions, and moderate consumption of red wine. In this way, it proposes the following 10 tips to achieve and set dietary goals (11):

1. Use olive oil as the main cooking fat.
2. Consume abundantly foods of plant origin (fruit, vegetables, legumes, mushrooms, and nuts). Vegetables should be eaten at lunch and dinner; at least one serving must be raw. A wide variety of textures and colors provides greater diversity of antioxidants.
3. Cereals should be consumed daily, preferably in their integral form. In this way, the loss of some nutrients during the refining process is avoided.
4. You should choose fresh, seasonal foods and little or no processed foods.
5. It is advisable to consume dairy products daily, mainly yogurt and cheese.
6. Red and processed meat should be eaten in moderation. The consumption of red meat in stew-type preparations is recommended.
7. The consumption of 3 or 4 eggs per week and at least three servings of fish is recommended. Blue fish should be consumed at least once or twice a week, to benefit from its cardioprotective fat content for humans.
8. The dessert of preference should be fresh fruit. Sweets and pastries should be consumed only occasionally.
9. To ensure adequate hydration, it is recommended to consume between 1.5 and 2 liters of water per day, according to personal needs. In this way, water is the preferred liquid to achieve adequate hydration, which can be combined with herbal infusions or broths low in fat and salt. Wine should be taken during meals, and always in moderation.
10. In addition to all the above, it is advisable to perform physical activity daily.

However, the MedDiet pyramid is not limited to nutritional recommendations. It includes recommendations on other elements of lifestyle such as daily physical activity, adequate rest, and the choice of traditional products, local, seasonal, diverse, and sustainable for the environment. In addition, it encourages culinary activities and socializing during meals (11).

The MedDiet has been described as protective against diabetes (17), metabolic syndrome (18, 19), cardiovascular disease (20, 21), and neurodegenerative diseases (22). Moreover, the MedDiet is inversely associated with the risk of malignant diseases, including colorectal, gastric, and breast cancers, and cancer-associated mortality (23). It has also been linked with improved survival in people with a history of cardiovascular disease (9) and ultimately with a lower risk of chronic diseases (24) and all-cause

mortality (25). In addition, high adherence to the MedDiet has been associated with a lower risk of frailty in the elderly (26).

Methods of assessment of adherence to the MedDiet

Adherence indices to the MedDiet are tools that allow quantifying compliance with the MedDiet pattern. Based on the literature data, Hernandez Ruiz et al. (2015) identified 22 indices proposed for the assessment of the MedDiet pattern (27). These indices include different dietary factors (different foods or food groups, nutrients and their ratios) that can have positive or negative health effects. While fruit and vegetables are the most common positive components, meat is usually found among the negative ones. In addition to the type of components, there is some heterogeneity among the numbers of components, and evaluating scores (through medians, tertiles or established portions) (27). Some new indices have emerged (28, 29), although they are similar to those summarized by Hernández Ruiz et al. (27). The MedDiet indices are useful for evaluating the quality of diet in epidemiological studies (30). However, it should be taken into account that other indices of diet quality have been developed for different eating patterns, such as indices for the vegetarian diet pattern (31–33).

Among the various tools, the validated 14-item questionnaire of MedDiet adherence is one of the most commonly used to assess adherence to the MedDiet for different populations (34, 35). If participants adhere to the intake established in the question (or item), 1 point is scored. On the contrary, if they do not comply with the established intake, 0 points are awarded for that item. Finally, the scores of all items are summed to obtain the MedDiet adherence score. Table I shows questions included in the 14-item MedDiet Adherence Screener questionnaire.

Table I The 14-item Questionnaire of MedDiet adherence (34)

Tabela I Upitnik o pridržavanju mediteranske ishrane sa 14 pitanja (34)

Items	Criteria for 1 point
1. Do you use olive oil as main culinary fat?	Yes
2. How much olive oil do you consume in a given day (including oil used for frying, salads, out-of-house meals, etc.)?	≥4 tbsp
3. How many vegetable servings do you consume per day? (1 serving: 200 g [consider side dishes as half a serving])	≥2 (≥1 portion raw or as a salad)
4. How many fruit units (including natural fruit juices) do you consume per day?	≥3
5. How many servings of red meat, hamburger, or meat products (ham, sausage, etc.) do you consume per day? (1 serving: 100–150 g)	<1

6. How many servings of butter, margarine, or cream do you consume per day? (1 serving: 12 g)	<1
7. How many sweet or carbonated beverages do you drink per day?	<1
8. How much wine do you drink per week?	≥ 7 glasses
9. How many servings of legumes do you consume per week? (1 servings: 150 g)	≥ 3
10. How many servings of fish or shellfish do you consume per week? (1 serving 100–150 g of fish or 4–5 units or 200 g of shellfish)	≥ 3
11. How many times per week do you consume commercial sweets or pastries (not homemade), such as cakes, cookies, biscuits, or custard?	<3
12. How many servings of nuts (including peanuts) do you consume per week? (1 serving 30 g)	≥ 3
13. Do you preferentially consume chicken, turkey, or rabbit meat instead of veal, pork, hamburger, or sausage?	Yes
14. How many times per week do you consume vegetables, pasta, rice, or other dishes seasoned with sofrito (sauce made with tomato and onion, leek, or garlic and simmered with olive oil)?	≥ 2

Antioxidative and anti-inflammatory potential of the MedDiet

The MedDiet can be considered a plant-based eating pattern, due to its high intake of plant foods compared to foods of animal origin (12, 15). The benefits attributed to the MedDiet are supposed to be the result of synergistic combination of the $\omega 6:\omega 3$ fatty acids balance, high intakes of oleic acid, fiber, and polyphenols (36). These compounds exert antioxidant, anti-inflammatory and antithrombotic effects and contribute to maintaining a normal lipid profile among people who follow this pattern (36-38) and its beneficial effects have been seen in people at high cardiovascular risk and in patients with non-alcoholic fatty liver disease (39, 40). Furthermore, a recent review showed that certain polyphenols found in the MedDiet play a significant role in preventing and treating chronic diseases, including obesity. Hydroxytyrosol, hydroxycinnamic derivatives, quercetin, resveratrol, and oleuropein, renowned for their antioxidant and anti-inflammatory properties, demonstrated effective anti-obesity effects (41).

There is evidence that a higher adherence to the MedDiet was in inverse correlation with plasmatic inflammatory markers such as adiponectin, leptin, tumor necrosis factor alpha (TNF α), plasminogen activator inhibitor 1 (PAI-1) and high-sensitivity C-reactive protein (hs-CRP), among adults and adolescents (37). The inflammatory potential of the MedDiet was confirmed using the Dietary Inflammatory Index (DII). The DII score

considers the effects of diet on six inflammatory biomarkers: Interleukin 1 beta (IL-1 β), interleukin 4 (IL-4), interleukin 6 (IL-6), interleukin 10 (IL-10), TNF α , and hs-CRP (42). Food parameters are assigned a negative score “-1” if their effect is anti-inflammatory, a positive score “+1” if their effect is pro-inflammatory, and “0” if no significant effects in inflammatory biomarkers are observed (42). Based on the DII, patients with metabolic syndrome with higher adherence to the MedDiet pattern had more favorable anthropometric and blood biochemical parameters, and a better oxidative and inflammatory status (38).

Since olive oil is one of the specific foods of the MedDiet, some of its health-promoting potentials specific compounds were studied (43, 44). There is evidence from *in vitro* and animal models studies that hydroxytyrosol, a polyphenol compound occurring in olive and olive oil, exhibited antioxidant, anti-inflammatory, anti-platelet aggregation and anti-atherogenic effects (43).

Furthermore, supplementation with hydroxytyrosol has been linked to an improvement of antioxidant status in subjects with one or more components of metabolic syndrome (44). Besides single foods and their ingredients, the antioxidant effects of Mediterranean traditional recipes were studied too. Based on the polyphenol and lycopene contents, their bioaccessibilities and antioxidant activities, “Pizza Napoletana marinara”, included in the register of traditional specialties guaranteed (TSG), is a good example of the importance of traditional preparation of foods to fully exploit their nutraceutical potential (45).

The Mediterranean lifestyle

The MedDiet, described above, is only one aspect of the Mediterranean lifestyle. The Mediterranean lifestyle has not been explicitly defined. However, there does seem to be a consensus on a series of factors related to the Mediterranean lifestyle (12).

In its diet guide published in 2010, the MedDiet Foundation includes, in addition to diet, daily physical activity, adequate rest, and choosing traditional, local, seasonal, diverse, and environmentally sustainable products. It also encourages culinary activities and socializing during meals (11).

Diolintzi et al. (2019) described the Mediterranean lifestyle as a healthy way of life characterized by a Mediterranean, plant-based diet, physical activity, rest, and socialization (12). The MedDiet is not related only to specific food intake but also considers the seasonality of food, moderation in quantities, participation in culinary activities and commensality, or in other words, social context of eating and food choices. Other factors such as exposure to stress, social norms, or hours of exposure to sunlight may also be relevant, although their health effects have not yet been studied well. Social aspects, such as preparation, serving and consumption of food have been related to better eating habits, as well as better nutritional status. Similarly, engaging in group physical activity improves physical and social well-being (12), and avoiding a sedentary lifestyle is also beneficial against obesity and lowers the risk of metabolic syndrome (46).

The social and "eco-friendly" behaviors affect chronic diseases, but also dimensions of environmental, social, emotional, and intellectual well-being (12). There is evidence that the Mediterranean lifestyle is protective against all-cause mortality and could enhance longevity (47, 48). Adherence to the Mediterranean lifestyle was associated with delayed premature mortality by 8.4 years in men, and by 15.1 years in women (49).

A healthy lifestyle score was created in one study considering the adherence to the MedDiet, the physical activity level and the smoking status. A higher adherence to the MedDiet and physical activity and a lower smoking status were evaluated as positive. Adherence to two and three components of the Mediterranean lifestyle was found to reduce 20-year mortality in young and older adults by 56% and 76%, respectively (50). It protects not only against all-cause mortality, but also against cardiovascular diseases (21). The estimated protection against non-fatal cardiovascular events was between 57 and 62%, and around 59-67% against fatal cardiovascular events. When sleep pattern was considered, the protective effect rose to 65% and 83% respectively (51, 52). Sleep pattern and its quality are still being studied, but they seem to affect cardiometabolic risk factors and the risk of mortality (12).

Following healthy lifestyles such as the MedDiet lifestyle is included in health promotion activities for noncommunicable disease prevention (53). This prevention should be carried out at both individual and society levels to increase the population's quality of life (54). There are various strategies that can be implemented at both the population and individual levels to increase adherence to the MedDiet and promote healthy eating habits. Public awareness campaigns, nutrition education, cooking classes, recipe blogs, workplace wellness programs, policy changes, food labelling and marketing or personalized dietary counselling would all help to achieve greater adherence to the MedDiet and the MedDiet lifestyle. Successful adherence to it may require a combination of these strategies, tailored to the specific needs and cultural context of the target population (2, 11, 55).

Besides its health-beneficial effects, the MedDiet has also been found to be an environmentally sustainable diet. Recent research demonstrates that the MedDiet is an environmentally friendly choice, and that the adherence to the MedDiet is inversely associated with greenhouse gas emissions, particularly carbon dioxide (CO₂) emissions (56). A recent systematic review also found that MedDiet had lower carbon, water and ecological footprints compared to Western diets (57). These findings could contribute to informing and endorsing public health initiatives and dietary guidelines, ensuring that recommendations promote dietary changes that could have protective effects on people's health and the environment.

Conclusion

In conclusion, the MedDiet is a healthy eating pattern associated with numerous health benefits. It emphasizes the consumption of plant-based food such as fruit, vegetables, whole grains, legumes, nuts, and olive oil, which are rich in antioxidants. These antioxidants, such as polyphenols and oleic acid, contribute to the MedDiet's anti-

inflammatory, anti-thrombotic, and lipid-improving effects. Adherence to the MedDiet is linked to a decreased risk of obesity, cardiovascular disease, diabetes, certain cancers, neurodegenerative diseases, and overall mortality. By adopting the MedDiet and embracing its lifestyle aspects, individuals can promote their health and well-being while respecting the planet, since MedDiet has also been described as an environmentally sustainable diet.

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Mediteranska ishrana i stil života

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Kratak sadržaj

Mediteranska ishrana se odlikuje visokim unosom voća, povrća, integralnih žitarica, mahunarki i maslinovog ulja, umerenom konzumacijom živinskog mesa i ribe, kao i ograničenim unosom crvenog mesa i minimalnom količinom prerađenih namirnica. Povezuje se sa brojnim zdravstvenim koristima, uključujući prevenciju i kontrolu metaboličkog sindroma, dijabetesa, kardiovaskularnih, neurodegenerativnih, kao i određenih vrsta malignih bolesti, ali i sa dužim životnim vekom i nižim rizikom od smrtnosti. Zaštitni efekti mediteranske ishrane povezani su sa njenim antioksidativnim i antiinflamatornim svojstvima. Mediteranska ishrana ne samo da pozitivno utiče na zdravlje, već je i ekološki održiva, budući da je u inverznoj korelaciji sa ekološkim indikatorima, kao što je emisija gasova koji izazivaju efekat staklene bašte. Osim mediteranske ishrane, mediteranski stil života podrazumeva redovnu fizičku aktivnost, dovoljno odmora, kao i druženje tokom obroka, koji se takođe povezuju sa pozitivnim zdravstvenim ishodima. Strategije prevencije hroničnih nezaraznih oboljenja trebalo bi da promovišu mediteranski stil života i sprovođenje programa rane detekcije i prevencije, kako na individualnom nivou, tako i na nivou društvene zajednice.

Ključne reči: mediteranska ishrana, mediteranski stil života, antioksidansi, inflamacija, zdravstveni efekti
