**ARE THE BENEFITS OF MEDITERRANEAN DIET SIMPLY DUE TO UNSATURATED FAT INTAKE?**

by

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Submitted to the Graduate Faculty of the

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Graduate School of Public Health in partial fulfillment

of the requirements for the degree of

Master of Public Health

University of Pittsburgh

2018

**ABSTRACT**

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The Mediterranean diet is highly recommended by modern nutritionists, being derived from the traditional diet of the Mediterranean countries, with a large number of fruits and vegetables, olive oil, plus an appropriate amount of wine as an important feature. This simple, light, but the nutritious diet is thought to prevent cardiovascular and other diseases. The traditional view, as well as many studies, indicated the positive effect of olive oil rich in unsaturated fatty acids on the prevention of diseases, such as cardiovascular disease. However, some of these studies seem not to be strict enough to prove these benefits. Here, we evaluated the effectiveness of unsaturated fats, as well as analyzing the effect of some other food components in the Mediterranean diet on the prevention of age-related diseases. The results show the effect of unsaturated fatty acid may be overstated and dietary fiber and antioxidants in the Mediterranean diet perhaps also play a role that cannot be ignored. Therefore, any beneficial effect cannot be attributed to a single factor such as unsaturated fatty acids. The purpose of this work is to discuss the significance of healthy diet in the general public health and occupational health perspectives; provide advice to guide the dietary structure and food selection of populations, especially for occupational groups who have to face high working stress and frequently ignore the importance of reasonable diet structure.

James Peterson, PhD

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# 1.0 introduction

The Mediterranean diet refers to the dietary style of eating vegetables and fruits, fish, whole grains, beans and olive oil as the main food in the southern European countries on the Mediterranean coast, such as Greece, Spain, France and southern Italy. It has been described and defined as “a plant-based diet characterized by a high ratio of mono-unsaturated to saturated fats with total fat accounting for 30-40% of daily energy consumption”[1]. It is a healthy diet that has many benefits to population health, for example, in reducing the risk of cardiovascular diseases (CVD). Nowadays, CVD is a worldwide public health issue and has been the number one cause of death worldwide. More people die each year from CVD than any other cause of death[2]. The main explanation of the benefits of Mediterranean diet in terms of preventing CVD is the usage of olive oil and the intake of unsaturated fatty acids [3, 4]. However, others indicated that some other substances, such as the salt content, oxidant, the amount of vitamin, also influence CVD prevention [5, 6].

The purpose of this essay is to examine the potential benefits of the Mediterranean diet; discuss the significance of healthy diet in the general public health and occupational health perspectives; then give suggestions to policy makers and stakeholders with regard promoting healthy diet modes represented by the Mediterranean diet. Potential readership includes public health students, stakeholders, public health practitioners and any members of the general public who may want to find information for changing their diet habits and life styles to a healthier path.

# 2.0 review

## 2.1 THE MEDITERRANEAN DIET

The Mediterranean diet is derived from the traditional dietary patterns of the Mediterranean Sea countries, such as Italy, Greece and Spain [7]. This diet pattern has a long history, but this diet pattern had not been popularized until several decades ago. It features lots of olive oil, natural grains, legumes, fruits and vegetables, as well as a fair amount of fish, dairy products (cheese and milk) and red wine, with few meat products and has been recommended by nutritionists [1] [8]. The focus of the Mediterranean diet is not to limit the intake of total fat, but to make choices about the type of fat consumed. It uses olive oil as the main fat source, replacing saturated fat or trans-fat, helping to lower LDL levels.

### 2.1.1 Mediterranean diet pyramid

A Mediterranean diet pyramid is shown below (Figure 1) to represent the main framework of Mediterranean diet and a recommendation of healthy diet pattern. The Oldways Foundation, which advocates a tasty, pleasant and healthy way of eating, released this chart for the Mediterranean Diet Pyramid in 2009[9]. It contains a variety of food types and groups, covering a wide range of the nutrition spectrum. At the base of the pyramid, activity and social connections are emphasized. The Mediterranean diet attaches great importance to moderate exercise and active social activities. It advocates sharing food with relatives and friends. In the meanwhile, vegetarian foods (or plant foods) are located at the lower of the pyramid, implying that these types of food are consumed in the largest amounts. Compared to the more typical Western (*e.g.* American) diet, which has large amounts of meat products, the Mediterranean diet provides more balanced nutrition, contains more fibers, antioxidant substances and vitamins.

The specific structure is as follows:

The spire (fifth level): red meat and sweets.

The fourth floor: poultry meat and eggs; cheese and dairy products.

The third floor: fish and shellfish.

Second floor: cereals, vegetables and fruits; olives and olive oil; beans, nuts and melon seeds; herbs and spices.

First floor: Sports and fun.

Tower side: red wine and water.

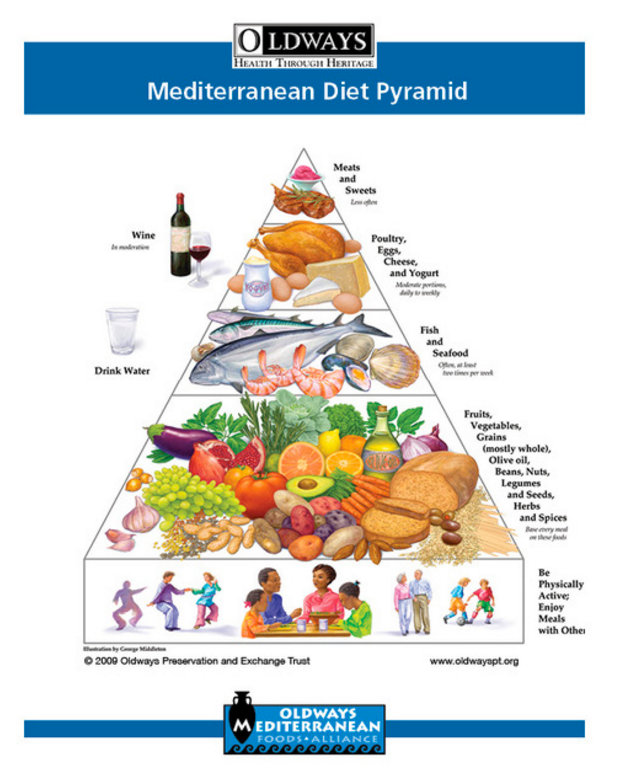


Figure : Mediterranean diet pyramid

### 2.1.2 Differences between Mediterranean diet and other diet pattern

The Western diet has many features to distinguish it from the Mediterranean diet: high energy density (processed foods), more processed meat and red meat, high-fat dairy products, refined grains, fructose, sugared drinks, less intake of fruits, vegetables, dietary fiber and fish.

Traditional Asian dietary patterns are characterized by large intake of vegetables, fish, and less intake of red meat. For example, the traditional Japanese diet shares similarities with the Mediterranean diet, including intake of cereals, beans, seafood, vegetables and fruits [10]. With rapid economic development, some traditional Asian dietary patterns, such as those of China and India, have changed [10]. The protective dietary factors have gradually been replaced by poorer dietary factors such as sweets, high carbohydrate foods, fats and red meat. In many Asian countries, CVD and increased incidence of obesity, have been associated with changes in diet patterns. In a study conducted in China and Japan, high intakes of high glycemic index foods (e.g., white rice) doubled the risk of developing type 2 diabetes[11]. In contrast, the Mediterranean diet seems to represent a healthier lifestyle, with protection of the cardiovascular system and kidneys, slowing the development of metabolic syndrome, slowing the decline of cognitive function, reducing the risk of specific tumors and prolonging life expectancy [12, 13].

## 2.2 Health effects of Mediterranean diet

The Mediterranean diet has been considered as a model for a balanced and healthy diet in the world at present. It has many health promotion features and seems to play~~s~~ an important role in preventing many diseases. NIH-AARP diet and health studies have shown that the Mediterranean diet, is apparently health-friendly and reduces mortality [14]. A systematic review and meta-analysis of observational studies with regard~~s~~ to CVDs by Rosato et al. [15] indicated that, the Mediterranean diet has a protective effect on the risk of CVDs by presenting inverse associations between CVDs , coronary/ischemic heart disease and acute myocardial infarction versus Mediterranean diets. Another 10-year study conducted by Linton Harris et al. in Australia [16] showed that traditional Mediterranean diets (eating more vegetables, fruits and fish, eating less of other animal products) indeed seemed to prevent heart disease. Specifically, Mediterranean-born immigrants have a lower rate of death from heart disease than native-born Australians and, in addition, people eating the most traditional Mediterranean foods are 30% less likely to die of CVD than those who eat the least amount of Mediterranean food.

In addition to the benefits of preventing cardiovascular disease, Mediterranean diets can also help improve the brain function. The Mediterranean diet was found in many epidemiological and randomized controlled trials to have a positive effect on cognitive ability[17]. Studies have found that people whose diet is highly similar to the Mediterranean diet have a slower rate of decline in cognitive ability, as well as lower probability of developing Alzheimer's disease[18]. However, more long-term, perspective, randomized control trials are needed to verify whether the Mediterranean diet can help prevent or delay the occurrence of Alzheimer's disease and dementia.

Furthermore, regardless of whether they are residents of the Mediterranean or living in other places, a study found that eating a Mediterranean diet can significantly reduce the risk of death, that is, the chance of living longer [19].

As per the explanations of the benefits of Mediterranean diets, the most popular one is the usage of olive oil. Consider, for instance, that in comparison to butter, widely used in the American diet, olive oil has significantly larger proportion of monounsaturated fatty acid [20, 21]. Interestingly, many Mediterranean countries have used olive oil to the maximum, making them the largest producers, consumers and exporters of olive oil [22]. Moreover, due to the olive oil's role as the primary source of fat, the Mediterranean diet is high in monounsaturated fatty acids [23]. According to the study from Christina et al., there is a negative correlation between the amount of olive consumption per capita and rates of CVD mortality in selected countries[22].

## 2.3 Unsaturated Fatty Acids and Health Effects

Unsaturated fat refers to a fatty or fatty acid chain containing at least one double bond. If there is only one double bond, then it is called monounsaturated fat (Figure 2[24]); while more than two double bonds are termed polyunsaturated fats. When a double bond is formed, a pair of hydrogen atoms is eliminated, so the hydrogen atoms bound to the carbon atoms do not reach their maximum, *i.e.* the carbons remain "unsaturated."

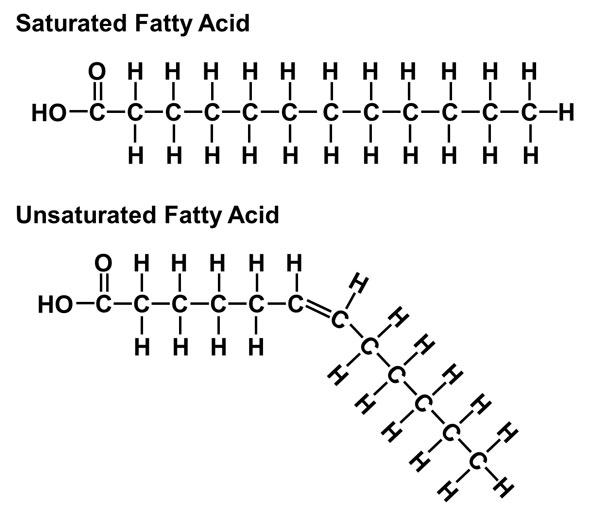


Figure : Examples of saturated fatty acid and unsaturated fatty acid

Unsaturated fatty acids play an irreplaceable role in maintaining cell structure and function. It is commonly accepted that the fluid mosaic model, which is proposed by Singer and Nicolson in 1972[25], is the main structure of biological membranes that are composed of two layers of phospholipid molecules. This model emphasizes the fluidity and mosaicism of cell membrane. In 2007, research from Wydro et al verified the influence of fatty acids on model cholesterol/phospholipid membranes[26]. The result indicated that the fluidity of biological membranes depends upon the ratio of unsaturated to saturated fatty acids. Compared to saturated fatty acid, unsaturated fatty acid could make member more fluid.

It is well established that saturated fatty acids (SFA) are associated with increased levels of low-density lipoprotein (LDL) cholesterol in blood, which is a strong risk factor for CVDs [27]. The National Lipid Association Panel also noted that substituting SFA with unsaturated fats, proteins, or carbohydrates reduced the level of atherogenic cholesterol, but substituting unsaturated fats or proteins resulted in a greater reduction than carbohydrates [28]. Another study conducted by Briggs et al. claimed that, based on the evidences from their perspective study and randomized controlled trials, replacing dietary saturated fatty acid (SFA) with unsaturated fatty acids could benefit cardiovascular health [29].

1. **Analysis**

## Opposite Opinion for The Effect of Unsaturated Fatty Acids

Due to the diversity within Mediterranean diets, the benefits to public health may not simply be due to single substance. Other nutrients or ingredients contained in Mediterranean diets may also prevent disease. In the geographical distribution of the prevalence of heart disease, the Mediterranean region is indeed lower than the rest of the world, but it is unclear exactly which factor contributed to this phenomenon. There may be widespread belief that this is the impact of monounsaturated fatty acids from olive oil, but many animal experiments have found that compared with saturated fatty acids, the monounsaturated fatty acids have no obvious effects with regards to, for example, prevention of atherosclerosis [30, 31]: completely opposite to the epidemiological point of view. Another interesting observation is that, from a mainstream nutritional point of view, the Mediterranean diet is considered a paradox: while people in the Mediterranean consume relatively high amounts of total fat, they have a much lower rate of cardiovascular disease than other people who consume the same amount of fat, such as the United States.

In addition, some researchers challenged the mainstream opinion in terms of saturated fatty acid, holding the point that the harm of saturated fatty acids is unconvincing, and the effects of unsaturated fatty acid may be overstated. Nina Teicholz, author of a book named The Big Fat Surprise, put forward a totally opposite view in terms of the health effects of saturated and unsaturated fatty acids. In her book, she reevaluated the research in terms of the health effects of the Mediterranean diets and fatty acids, especially the findings of the famous seven country study [3]. Her investigation identified many potential flaws in the experimental methods. For example, Ancel Keys, the conductor of the study, seemed not to follow randomization and avoid bias. According to Tiecholz’s investigation, “keys’s selection criteria could not be called random; instead, as he wrote, he chose places that the thought showed some contrast in rates of diet and death[32]”. It is inappropriate and unacceptable to deliberately select experimental data and avoid conflicts with its own hypothesis. Second, the sampled foods are also different. Some food samples are cooked at the time of collection, some are not cooked, and others are a mixture of raw and cooked foods. This means that the method of investigation has a great deal of arbitrariness and is not consistent.

Another study conducted by Yerushalmy and Hilleboe also critiqued keys’ view. According to their research, they analyzed the mortality from Arteriosclerotic and Degenerative Heart Disease and Percent of Total Calories from fat for Males aged 55-59 in twenty-two countries for which national data were available in 1955. The results show that there is no correlation of dietary fat with heart disease[33]. Yerushalmy suggested that other factors may equally well explain the trend in hart disease in all those countries [34].

## 3.2 other explanations for the benefits of Mediterranean diet

### 3.2.1 Intake of vegetables and fruits

People who strictly follow the Mediterranean diet pattern consume large quantities of vegetables and fruits, as well as whole grains. These foods contain many types of nutrients, including vitamins, minerals, flavonoids and terpenes, many of which have antioxidant function. For instance, vitamins A, C, E and polyphenol are excellent in oxidation resistance and are abundant in fruits, vegetables and olive oil. Some research indicated that antioxidants not only help control cholesterol and lower LDL cholesterol, but also have anti-inflammatory and antihypertensive effects [35]. These antioxidants can offset the destruction of free radicals on cells and reduce cellular oxidative stress from reactive oxygen metabolites [36]. In addition, polyphenols in olive oil and red wine can also promote athero-protection. Red wine is rich in flavonoids (anthocyanins, flavanols, *etc.*) and non-flavonoids (resveratrol, gallic acid). Polyphenols can also inhibit LDL oxidation, increase the expression and activity of nitric oxide synthase (eNOS) mRNA in vascular endothelial cells, mediate vasodilation and the proliferation of vascular smooth muscle cells through nitric oxide [37, 38]. Carluccio *et. al.* found that antioxidants, like polyphenols, can inhibit the expression of endothelial adhesion molecule, which is a key factor in the early period of atherogenesis [39].

### 3.2.2 Wine

The intake of wine occupies an important place in the Mediterranean diet. The composition of wine is quite complex. Besides water and alcohol, there are more than 1,000 kinds of additional constituents, 300 of which are more important. Studies have shown that some substances contained in red wine have cardioprotective effects. Dudley *et al.* use rats as the experimental animals to explore the effect of resveratrol, tyrosol, and hydroxytyrosol in cardiovascular disease, since all three compounds are present at high levels in red wine and white wine [40]. The results indicated that both tyrosol and hydroxytyrosol showed varying degrees of cardioprotective effects by improving post-ischemic ventricular function, reducing myocardial infarct size and cardiomyocyte apoptosis, as well as decreasing the probability of peroxide generation.

However, some people hold different opinions with regard~~s~~ to the effects of wine in preventing cardiovascular diseases. There are three main reasons that have been put forward to question the health benefits of wine. First, it is obvious that one cannot simply ignore the adverse effects of alcohol. Second, like the rat experiment mentioned above, most of the studies or experiments on resveratrol or tyrosol are based on animals and it is inconclusive whether or not the same effect occurs in humans. Third, the amount of resveratrol or tyrosol in red wine or white wine may not be enough to produce any significant health effect. Experiments in rats have shown that resveratrol may prevent obesity and diabetes, both of which are risk factors for cardiovascular disease [41]; but if people want to intake comparable amounts of resveratrol to rats in the experiment, one would need to drink quantities of wine that would far exceed the daily recommended intake

### 3.2.3 Grains

In the Mediterranean diet, grains are regarded as a good source of carbohydrates and dietary fiber. Compared to dietary patterns in which more refined carbohydrates are consumed, like white rice or refined flour, Mediterranean diets always contain whole grains, which have a high amount of dietary fiber. The benefits of dietary fiber are three-fold.

First is regulation of blood lipids. Increasing dietary fiber intake can lower serum cholesterol and low-density lipoprotein cholesterol (LDL-C) levels. In particular, oats can significantly reduce the density of small and dense LDL-C, reduce the number of LDL particles, and will not affect the blood high-density lipoprotein cholesterol (HDL-C) concentration [42, 43]. In other words, dietary fiber reduces "bad" cholesterol without affecting "good" cholesterol.

Second is prevention of high blood pressure. A prospective analysis from the NutriNet-Sante Cohort conducted by Lelong *et al.* analyzed the effects of dietary factors on hypertension. The results indicated that the hazard ratio (Q4:Q1) of dietary fiber is 0.81 with the 95% confidential interval of 0.71-0.93 [44]. This means that, compared to the low quartile subjects who have low intake of dietary fiber, the risk of hypertension in high quartile subjects who consume more dietary fiber is 19% lower.

Third is blood glucose control. A research from Netherlands used sows as experimental subjects and sugarbeet pulp as a source of dietary fiber to explore whether fermentable dietary fiber can stabilize the level of blood glucose[45]. The results confirmed the hypothesis and indicated a prolonged satiety feeling with high dietary fiber meal.

### 3.2.4 Salt (NaCl) Content

Salt plays an important role in maintaining the life functions of the human body. Many studies have shown that too much salt can be harmful; high-salt diets can cause high blood pressure, heart disease and other cardiovascular diseases. A meta-analysis of prospective studies conducted by Pasquale Strazzullo *et al.* suggested that high salt intake is associated with significantly increased risk of total cardiovascular disease, with a pooled relative risk of 1.17 with the 95% confidence interval 1.02 to 1.34 and the p-value of 0.02 [46]. The World Health Organization suggested that that adults consume less than 5 g of salt per day, which is equal to about one teaspoon. However, most people consume too much salt daily, about 9 to 12 grams, about twice the maximum recommended intake [47]. Excess sodium is linked to adverse health outcomes, including increased blood pressure and the risk of cardiovascular diseases [5].

Compared to the American style diet, which has a high level of salt, the Mediterranean diet includes control of salt intake. Since few studies have focused on the salt content in the Mediterranean diet, it is difficult to obtain relevant data regarding the average intake for people who are adherent to the Mediterranean diet. According to the Mediterranean diet pyramid (Figure 1), less added salt is used. Instead, herbs, spices, garlic and onions are frequently used for flavor adjustment. It is obvious that the Mediterranean diet has paid more attention to the intake of salt. Further studies should be conducted to collect and compare the salt intake between the Mediterranean and other diet patterns.

1. **discussions**

The Mediterranean diet is not specific to certain foods, but a healthy way of life, it contains a wealth of knowledge and customs [48]. It teaches how to choose food, how to cook, how to feel good, supplemented by proper exercise and rest. It is clear that the health benefits of Mediterranean diets may be explained by the multifactor functioning and interaction among many substances. This essay summarized the benefits and health effects of Mediterranean diet, the potential source of food in Mediterranean diet which have positive effects to health, and the debates with regards to saturated fatty acids and unsaturated fatty acids. It is lopsided to only attribute the benefits to the intake of unsaturated fatty acids and probably lacking in insight to attempt to understand these benefits simply by focusing on the relative levels of individual dietary substances. What’s more, due to the big controversy with regards to the benefits of fatty acid, more rigorous researches and investigations should be conducted to evaluate the true effect of unsaturated fatty acid. This essay has considered the benefits of Mediterranean diets at a food-based rather than molecular level. The unnecessary use of scientific terminology, proper noun or scientific name for some substances may represent an avoidable barrier to communication with the public. In a recent paper on healthy diet, Liu *et al.* also emphasized the importance of reducing customer confusion. They mentioned that, although much research has confirmed the hazard of high-fat dietary, many consumers and food stakeholders are still puzzled by the role of dietary fat in disease risk and the source of healthy fat [49]. Describing the scientific findings in a generally straightforward manner and giving dietary advice through food-based suggestion, will help popularize the findings in the public domain and may make up for any misconceptions of what constitutes a healthy diet.

Despite the controversial and unexplored part of the food that really works in the Mediterranean diet, the benefits of the Mediterranean diet are unquestionable. Public health practitioners and policy makers should learn from the model of the Mediterranean diet and combine local conditions to formulate nutrition recommendations that meet the conditions of local residents or special work populations. At present, occupational disease risks show a new trend of change. On the one hand, people with high risk are transferred from physical laborers to mental laborers [50]. With the developing and upgrading of industrial structure, the main body of workers has been converted from industrial workers to office agents. Some "office illness" has become a major factor in inducing occupational risks and occupational disease risk among office agents. On the other hand, due to long-term work overdraft, high work stress, lack of exercises and irregular diet, some risk factors of cardiovascular disease, such as obesity and atherosclerosis will develop over time. If person do not pay attention to them, serious consequences would appear. To some extent, officers should follow health diet pattern like the Mediterranean diets to prevent the potential health risk from work situation, The research of Public health practitioners and policy makers should.

Finally, Public health practitioners and policy makers should make efforts to popularize health diet model on a global sale. The global promotion of the Mediterranean diet may help to change the concept of “healthy” diet, transforming it into a conscious and sustainable development of nutrition, healthy and active, and a healthy way for everyone to achieve.

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