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## The mediterranean diet's effect on stroke risk



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### Abstract

The Mediterranean diet has been growing in popularity as preventive medicine has made way in the healthcare community. Doctors are telling patients to adopt this diet due to its role in lowering stroke rates and other cardiovascular diseases in both Italy and Greece. These two countries have some of the lowest stroke numbers in the world, and experts believe this is the result of the diet and lifestyle of the people of that region. The diet includes foods such as fruits, vegetables, nuts, fish, and olive oil, along with less cholesterol, saturated fats, and trans fats. These specific foods and combinations of foods include properties that can prevent high blood pressure. We will explore the capabilities of the Mediterranean diet in preventing stroke, and the importance of preventive medicine in healthcare.

**Keywords:** stroke, nutrition, preventive medicine, Mediterranean diet

### Introduction

A common saying describing the US Healthcare system is that it is not, in fact, considered a healthcare system, but is a sick care system. This is due to the healthcare system's prioritization of treating disease after symptoms have presented in a patient as opposed to teaching patients how to prevent the disease. One of the most prevalent examples of this is stroke. Some experts say that up to 80% of strokes could be prevented through healthy lifestyle choices, which would lead to better control of blood pressure. Eating a healthy diet/better nutrition, engaging in regular exercise, and maintaining a healthy weight all reduce the risk of cardiovascular events (Hankey, 2005). Usually, preventive medicine is not prioritized in the United States as prevention is not as profitable as treating symptoms/diseases after they develop (Harrah, 2015). Recently, however, doctors have started to realize the benefits of preventive medicine to general patient care. This has led to studies and research that describe what exact measures patients must take to prevent the occurrence of diseases. When it comes to stroke, some patients in the US assume that if they have a family history they have limited control over their susceptibility to its occurrence. While family history plays a large part in one's individual susceptibility to stroke, environmental factors such

as weight, nutrition, and exercise also play a role (Yu et al., 2019). Practicing a healthy lifestyle does not guarantee the prevention of certain diseases. However, when looking at the overall occurrence of stroke, it is evident that patients who improve environmental factors affecting their susceptibility face a significantly decreased risk of stroke no matter what their genetic risk may be. We will examine the effectiveness of multiple preventive lifestyle techniques for reduction of stroke risk, focusing on Mediterranean nutrition and better lifestyle choices.

Stroke is one of the primary preventable burdens on the US healthcare system; it is often survivable but can lead to numerous disabilities (Bauer et al., 2014). Preventive medicine can reduce this burden by treating the precursors to stroke rather than the after-effects. In the year 2000, over half of all deaths in the US were preventable, and still millions of people die every year from preventable disease (Mokdad et al., 2004). Proper measures such as screenings, nutritional modifications, increased exercise, and regular health checks help prevent chronic diseases. Many people are simply unaware of the steps they need to take in order to stay healthy as they age, and manage diseases they have. Ideally, doctors who practice preventive medicine screen their patient's genetic history and

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environmental factors in order to predict their susceptibility to diseases. Then, they recommend personalized preventive strategies that decrease a patient's risk of disease, such as proper nutrition choices, exercise, and other preventive measures. Stroke is one of the most effective examples of how prevention can change one's risk of developing a disease. Every year, more than 795,000 people have a stroke in the US, and it can cause a loss of cognitive, motor, and sensory function of the brain (Capriotti and Murphy, 2016).

### **Family History's Effect on Stroke**

Genetics have a limited but important role in stroke risk. Susceptibility to stroke before age 55 is largely based on family history (Michael and Shaughnessy, 2006). This is defined as any first-degree relative who had a stroke before age 55. Identifying this risk should signal to the preventive physician that early intervention may be key in a patient's health. While at a young age, family history of stroke is perhaps the most important risk factor, as we age, environmental factors become more powerful predictors. Stroke is usually caused by high blood pressure or other factors when a patient is past the age of fifty-five. A family history remains an important risk factor in patients after the age of fifty-five along with other environmental factors.

### **Introduction to Stroke and Risk Factors**

Stroke can be caused due to a blocked artery, or the leaking/bursting of a blood vessel in the brain. A blocked artery, or ischemic stroke, occurs when blood vessels in the brain become weakened or blocked by fatty deposits, debris, or blood clots. This can be due to a number of factors, but what usually causes blockages in the brain in elderly patients is high cholesterol (Dietschy and Turley, 2001). Cholesterol is made by the body and consumed through the diet. It is necessary for cell walls, hormones, vitamin D, and digestion, along with many other bodily functions. However, too much low-density lipoprotein (LDL) cholesterol, or bad cholesterol, in the blood can be detrimental. It can result in fatty deposits in blood vessels, which build up and cause narrowing with the potential for blockage. When this occurs, it causes a stroke. The leaking/bursting of blood vessels in the brain, or a hemorrhagic stroke, is less common but can be more deadly. This occurs when blood vessels, specifically in the brain, become blocked to the point where they burst or leak. It is similar to putting

pressure on a balloon to the point where it bursts or leaks air. This is often the result of high blood pressure (hypertension) which leads to high stress on the walls of the vessel. The blood from a ruptured vessel then puts pressure on the surrounding cells in the brain. This can significantly damage the cells, and the affected area of the brain to cease function. There are a multitude of other factors that affect one's risk for increased LDL cholesterol, high blood pressure, and stroke, such as lack of exercise, smoking, being overweight, and poor nutrition. These are the major factors that affect one's risk of stroke past the age of fifty-five. The Mediterranean diet, however, is one of the best interventions to reduce the risk of stroke, and therefore our best hope to prevent cerebro-vascular events.

### **The Mediterranean Diet**

The diet eaten on the Greek island of Crete, most commonly known as the Mediterranean Diet, is considered by experts to be the most useful in preventing the onset of diseases, such as stroke. It consists of eating a plant-based diet, including whole grains, vegetables, legumes, fruits, nuts, seeds, herbs, and spices (Demarin et al., 2011). In addition, olive oil is the main source of added fat. Olive oil is a healthy fat as it is monounsaturated and better than the saturated fats and trans fats that are usually present in American cuisine. These saturated and trans fats contribute heavily to stroke risk. Fish, eggs, seafood, dairy, and poultry are also included in the Mediterranean diet; however, they are only eaten occasionally. Red meat is reserved for special events, and eaten very rarely.

### **The Mediterranean Diet's Effect on Cholesterol**

One of the largest nutritional changes one can make to prevent stroke is to consume less saturated and trans fats, which reduces LDL cholesterol. The Mediterranean diet has been shown to do this. Various studies have shown that those who primarily consume a diet similar to the Mediterranean diet routinely have lower total cholesterol levels than those who do not (Meslier et al., 2020). This primarily comes from the Mediterranean diet's prioritization of olive oil as the main source of fat, and the lower consumption rate of unhealthier types of fat. The olive oil in the Mediterranean diet increases key high-density lipoprotein (HDL) cholesterol functions, which remove excess cholesterol from arteries, serves as an antioxidant, and keeps blood vessels clear (Hernández et al., 2017). This reduces risk of stroke significantly. In addition, the

Mediterranean diet usually results in decreased consumption of sweets and desserts, which are often high in saturated fat. When less saturated fat is eaten, the body will produce less LDL cholesterol.

As stated previously, cholesterol is a fatty substance that helps build cells in the body. Humans usually obtain cholesterol through diet. It is critical for survival; however, issues arise when the body contains an excess of cholesterol. Increased cholesterol creates fatty deposits in the bloodstream, which can decrease blood flow. If these fatty deposits rupture, they can form a clot, which could cause a stroke. Studies say that the Mediterranean diet can reduce cholesterol by up to 3x the original amount (Kastorini et al., 2011), which makes it one of the most effective ways of lowering one's cholesterol.

### **The Mediterranean Diet's Effect on High Blood Pressure**

High blood pressure is also one of the most prevalent causes of stroke due to increased pressure on blood vessels in the brain, which can lead to cerebral bleeding and stroke. A study conducted in Spain suggested that the Mediterranean diet could reverse all changes in blood pressure related to age when compared to a regular diet (Bonaccio et al., 2012). This is huge, because age is one of the biggest contributors to higher blood pressure. If the Mediterranean diet prevents these changes, then one's blood pressure would not skyrocket as one gets older. Therefore, the risk of stroke would remain controlled despite aging. Patients who do not follow the Mediterranean diet, however, would still have a higher risk of stroke. Most of the influence the Mediterranean diet has on blood pressure is based on a combination of factors, such as healthy eating and increased exercise. The use of olive oil as fat is one of the most important factors in decreasing blood pressure. Olive oil is high in polyphenols, a micronutrient that occurs naturally in plants, which has a positive effect on blood pressure (Covas et al., 2006). Specifically, it enhances the response from the endothelium-derived factors, blunting blood pressure increase (Linder et al., 1990). This is what mainly contributes to lower blood pressure through the mediterranean diet, and significantly decreases one's risk for stroke.

### **The Mediterranean Diet's Effect on Obesity and Diabetes**

While the Mediterranean diet doesn't specifically limit the

number of calories one eats, calories will usually be less due to the amount of natural and healthy food that is eaten. The average number of calories one eats a day is approximately 1,527 calories for those that adhere to the Mediterranean diet (Davis et al., 2015). In addition, the average number of calories a sedentary person burns in a day is around 1800 calories. The average number of calories an active person burns in a day is 1900-2200 calories. Thus, whoever follows the Mediterranean diet may be in a caloric deficit, resulting in weight loss. While different people lose weight at a different pace, being in a caloric deficit has the potential to decrease obesity. Obesity puts one at a higher risk of stroke due to high total cholesterol levels, and higher blood pressure (Winter et al., 2008). Also, with obesity, it is harder for blood to circulate, contributing to an increased chance of blockage in the brain. In a study, 10 subjects who previously had coronary artery disease were placed on the Mediterranean diet for 8 weeks along with regular exercise. They went to weekly informational sessions, and completed food-related questionnaires to analyze their food intake. The control group, another 10 subjects, were told to go about their daily life with no changes relating to health and nutrition. All 10 subjects in the experimental group had a significant decrease in weight compared to the control; simply because of diet and exercise (Noites et al., 2015).

Obesity also has a very strong correlation with the occurrence of Transient Ischemic Attacks, also known as mini strokes. These attacks, which can be quite dangerous, are frequently considered early warning signs of stroke. In fact, up to 15% of people who have a TIA have a stroke within 3 months (Coull et al., 2004).

In addition, obesity can contribute to risk for diabetes due to insulin resistance. This is when body cells do not respond to regulate a person's insulin production. This also increases the risk of stroke as diabetes causes the blood vessels to become stiff. This is called arteriosclerosis. It increases chances of blockage or bleeding of the blood vessels (Abbott, 1987). The Mediterranean diet reduces the chance of developing diabetes due to healthy eating habits, and less sugary food consumption. A study found that following the Mediterranean diet resulted in lower blood sugar and hba1c levels because of the lack of processed foods within the diet. This improved insulin sensitivity and reduced insulin resistance (Martín-Peláez et al., 2020).

Exercise can help combat obesity and diabetes. Social

exercise, the act of exercising with a group of people, may be better than solitary exercise, as it contributes to better physical, mental and emotional health. The Mediterranean lifestyle includes social exercise through regular walking and outdoor activities (Sánchez-Villegas, 2016).

### **Mediterranean Diet's Effect on Patients in Italy**

A study was done in Italy that tracked the benefits of the Mediterranean diet on a large scale, and showcased the benefits of better nutrition on stroke prevention. The Mediterranean diet was shown to help Italians who suffer from high stroke risk. While the average Italian usually eats a more nutritious diet than the average American, the benefits of the Mediterranean diet are much more effective in preventing diseases such as stroke. The Italian study found that dietary changes reduced risk of stroke by up to 25% among participants (Iacoviello, 2018).

### **Mediterranean Diet's Effect on American Patients**

The Mediterranean diet has already been shown to help Americans reduce their risk of stroke, as well. When it comes to stroke prevention in the US, the Mediterranean diet showed the most promise out of all secondary interventions in preventing secondary occurrences of stroke. Secondary interventions are when patients start incorporating preventive measures after they have already had a stroke in order to lower their risk in the future. These interventions are one of the best ways to gauge the effectiveness of preventive measures. Five separate studies suggested that the Mediterranean diet has the most potential in preventing stroke (Dearborn et al., 2015). While the Mediterranean diet is not commonly practiced in the US, it has shown to be extremely effective in preventing strokes among all ages and races within the United States among those who adhere to the diet (Dearborn et al., 2015). A study compared Americans on the Mediterranean diet versus those adhering to a typical American diet, and showed that those adhering to the Mediterranean diet were less likely than their counterparts to suffer from a stroke over two years.

### **Benefits of Preventive Medicine**

If one has a significant history of stroke, or risk factors for stroke, they can still reduce their susceptibility to stroke. Stroke is the result of multiple risk factors. Modifying these factors is

the best approach towards preventing stroke. It is easier to prevent oneself from having high LDL cholesterol, high blood pressure, obesity, and diabetes which all contribute to raising the risk of stroke. The question, however, is to what extent can we prevent these diseases. Many assume that as they age, their health will deteriorate and their risk for disease will go up. While this is true, a major reason this is prevalent is because preventive medicine is not commonly used by the American Healthcare system to treat those who are susceptible to disease. If preventive measures like the Mediterranean diet were utilized by the healthcare system, stroke risk would most probably go down. In addition, most patients would be in better health overall, which would prevent other diseases, including cardiovascular diseases such as heart attacks. This all has to do with a concept called Healthspan, which explores how long humans are considered "healthy". While medication may quickly reduce cholesterol or high blood pressure, more so than diet changes, they are usually used after one's health has already gotten worse. If a patient's treatment plan utilized preventive measures early on, this would increase their healthspan as their overall health would be better as they advance through their life. This would make their body stronger, and if they must face a disease state, such as a heart attack or a stroke, the patient would have a better chance of surviving the incident. Overall, the Mediterranean diet and other preventive measures do so much more than just prevent stroke. They actually extend healthspan, and a population's ability to survive dangerous health conditions.

### **Recommendations**

In order to decrease one's risk of developing a stroke, the Mediterranean diet is the best possible intervention. When it comes to LDL cholesterol, blood pressure, diabetes, obesity, or exercise, no other treatment option is able to address each specific risk factor for stroke. As shown throughout the paper, stroke risk is not inherently based on one's genetic predisposition to the disease, but also on one's lifestyle choices and health as they age. By preserving one's health span, a patient could be healthier, could feel healthier, and live longer simply by adhering to a proper nutritional diet and exercise plan. While medication may be more effective in certain cases and instances, preventive medicine is the most cost-effective and health-conscious way of avoiding disease. Healthier Americans would mean a lower strain on the healthcare system, and better

diets would mean better overall health for Americans across the country. Physicians should make these specific recommendations when discussing the Mediterranean diet with their patients at high risk of stroke. First, they should mention the importance of low saturated fat and trans fat in their food, which means very little egg yolk, red meat, sweets/desserts, and full-fat dairy products along with avoidance of processed foods. In addition, patients should be instructed to focus on eating foods that are plant-based, such as nuts, whole grains, legumes, vegetables, etc. These provide necessary protein and nutrients to stay healthy. In addition, olive oil is the main source of added fat in the Mediterranean diet, and doctors must emphasize this as it is the diet's main source of monounsaturated fats and polyphenols, which lower blood pressure. Lower blood pressure is necessary in preventing stroke and other cardiovascular diseases. Finally, doctors must emphasize the importance of social exercise. The Mediterranean lifestyle, which includes exercise as a social event, is important. Patients must understand that in order to reduce their risk of stroke and adhere to the Mediterranean diet, they must participate in walking groups, yoga classes, weightlifting, hiking, or any kind of exercise that is done with others. These factors contribute the most to decreasing a patient's risk of stroke, which can help the US move towards being a country where healthspan increases, and patients are healthier due to preventive and natural measures versus consumption of high doses of medication.

### Limitations

While the Mediterranean diet does reduce one's risk of stroke by a substantial amount, some may argue that it is not the most effective method of preventing stroke. Some Cholesterol drugs, like statins, can reduce cholesterol as much as 50% or more (Feingold, 2020) at a rapid rate. However, while the Mediterranean diet may be able to reduce cholesterol by up to 3× the original amount, the reduction is not as rapid. This effectiveness of treatment is through modification of risk factors of stroke, which include high LDL cholesterol, high blood pressure, diabetes, and obesity.

### Conclusion

There is no accurate way to determine how much one's environment or genetics contribute to susceptibility for stroke. A better way to look at the problem is that one cannot change their genetics, so any aspect of lifestyle changed in a positive

way is beneficial for prevention of disease. Since one's environment is a factor that can be changed, any effort to change it in a positive way is likely to reduce one's risk of stroke. Personalized medicine is the best way to treat any type of disease. Focusing on preventing the factors that cause a certain disease will always result in a healthier patient than trying to treat a disease after its appearance. The core of preventive medicine is individualized attention, which is why every doctor in the US should be focusing on preventing disease when they first meet with their patients. Preventive medicine educates patients on lifestyle changes needed in order to preserve health and reduce risk of diseases. This form of healthcare is best for both patients and doctors, as it reduces disease and increases overall health, as shown through reduction in stroke and the Mediterranean diet's effect on prevention.

### Conflicts of Interest

The authors declare no potential conflict of interest.

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### Ethics Approval

This article does not require IRB/IACUC approval because there are no human and animal participants

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