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Mediterranean Diet: its Nutritional Composition and Health Benefits in Chronic Disease Prevention

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Abstract:

The Mediterranean diet (MD), as a scientifically proven healthy eating pattern, originated in the Mediterranean region and is gradually respected globally. In recent years, a large number of studies have confirmed its remarkable effect in the prevention and management of chronic diseases. However, there is still a certain research gap in the specific nutritional composition of the MD and its comprehensive understanding of health. Additionally, the widespread adoption of the MD faces challenges, including cultural differences and the adaptation of dietary habits. This article reviews the analysis of the major food groups and nutrients in the MD, exploring its health benefits in cardiovascular disease (CVD) prevention, management of type 2 diabetes and obesity, as well as cancer prevention. Through comprehensive existing research, this article reveals the scientific evidence of the MD to benefit health. The results of the research provide a scientific basis for promoting the MD, and provide direction for further studying the mechanism of the MD prevention disease in the future.

Keywords: Mediterranean diet, nutritional composition, cardiovascular disease, chronic disease prevention, cancer prevention.

1. Introduction

With the continuous development of society, individuals are increasingly seeking higher-quality diets, leading to a gradual diversification of food choices. However, this trend has also precipitated various health issues such as obesity, diabetes, and high cholesterol. Consequently, it is becoming increasingly important to prevent and manage chronic diseases through healthy dietary patterns. The Mediterranean Diet (MD), characterized by its abundance of protective nutrients and supported by extensive scientific evidence due to its long-standing history, offers significant advantages in combating obesity, improving high blood sugar and high blood lipids, reducing cardiovascular disease (CVD), and preventing cancer.

The MD is widely regarded as a healthy dietary pattern and lifestyle, primarily reflective of the traditional dietary habits of populations residing in Mediterranean coastal countries such as Italy, Spain, and Morocco. Key features of the MD include the consumption of vegetables, fruits, fish, whole grains, legumes, and olive oil, alongside moderate intake of dairy products such as milk and yogurt, and limited consumption of red meat, desserts, beverages, and refined grains. Populations adhering to this diet exhibit low incidences of heart disease, extended lifespans, and a reduced prevalence of chronic conditions such as diabetes and high cholesterol. The MD was recognized as one of the healthiest eating patterns in the 2015-2020 Dietary Guidelines for Americans.

According to the Food and Agriculture Organization (FAO), the number of undernourished individuals has risen to nearly one billion. Concurrently, obesity and its associated chronic diseases are also on the rise [1]. The MD has been rigorously verified and analyzed through numerous scientific and practical approaches, demonstrating its efficacy in addressing these chronic diseases. Clinical trial studies have revealed that among seven dietary regimens (low-fat, Mediterranean, very low-fat, modified fat, low-fat + low sodium, Ornish, and Pritikin), adherence to the MD is associated with the lowest risk of illness and mortality [2].

By analyzing the structure of the MD and considering global dietary habits and patterns, our aim is to offer a set of safe and healthy dietary recommendations for people worldwide, thereby effectively addressing the escalating problem of chronic diseases and tackling the severe challenges confronting global public health.

This review will conduct a comprehensive analysis of the MD‘s nutritional composition, focusing on its key food

constituents, and evaluate how these components synergistically benefit the body, ultimately contributing to the prevention of chronic diseases such as cardiovascular health, metabolic diseases, neurodegenerative diseases, and cancer. Through a systematic integration of existing literature, this review intends to provide a scientific basis and practical guidance for promoting healthy lifestyles and disease prevention.

2. Nutritional Composition of the MD

2.1 Main Food Groups

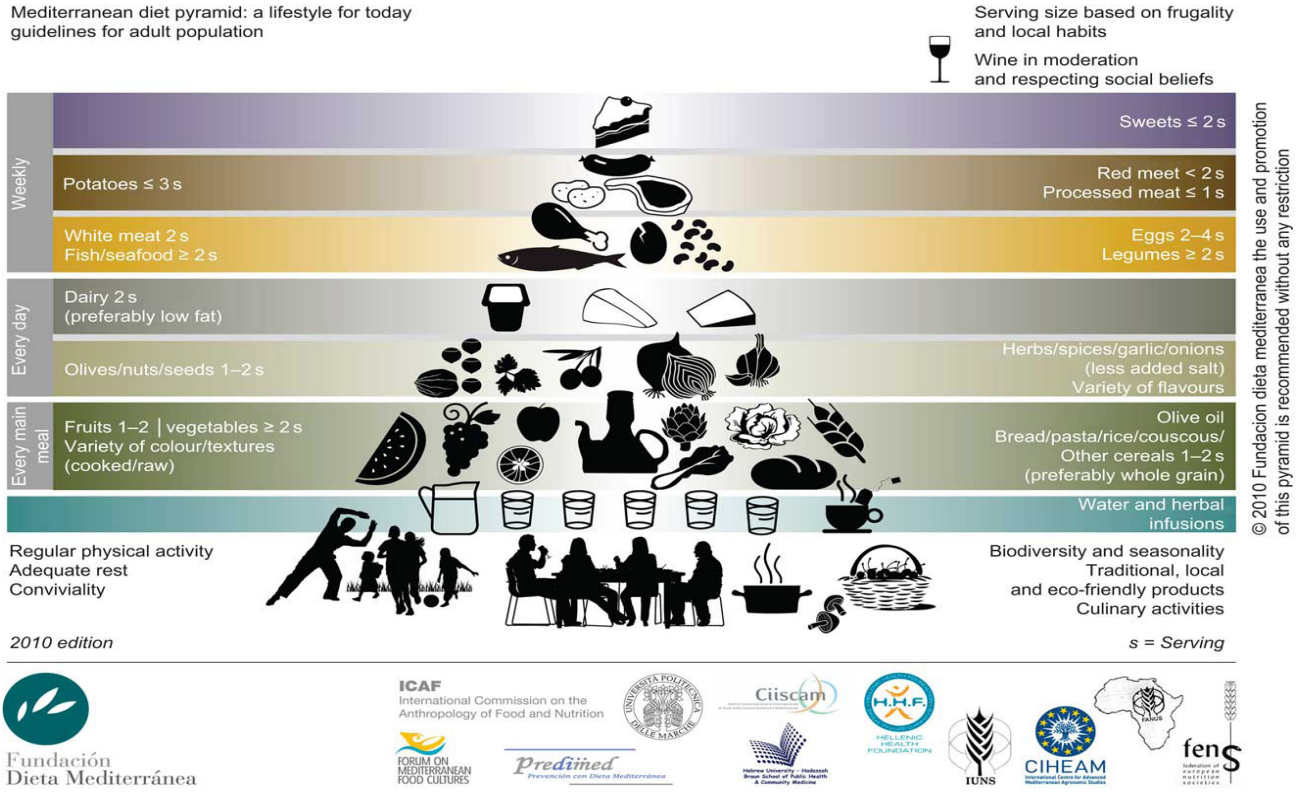

Figure. 1 MD pyramid [3]

The MD is a plant-based diet that emphasizes the intake of olive oil, whole grains, fish, nuts, and legumes, originating in Mediterranean countries such as Greece, Italy, and Spain. This diet not only focuses on the type and quality of food, but also emphasizes the moderate intake of red wine and limiting the intake of red meat, which is widely believed to contribute to health, especially for cardiovascular health has significant benefits [4].

In order to the further study of MD and its health benefits, it is necessary to set up a uniform standard for recommended intake of different food groups. This can be done by creating a nutritional pyramid (Figure 1) that reports the main foods of each specific MD and how often they are consumed, thus providing a standard for people who wish to follow the MD to refer to.

Figure 1 shows that the bottom of the pyramid represents the highest intake of food and is also the most recommended food, as the level of the pyramid rises, the amount of food intake needs to decrease accordingly. The MD consists mainly of vegetables, breads, various whole grains, legumes, and nuts, with fresh fruit often served as a daily dessert and olive oil as the main fat source [5]. Intake of dairy products (mainly cheese and yogurt), fish and poultry ranges from low to moderate. The number of eggs consumed per week is between two and four, while the intake of red meat is low. Alcohol is allowed, but in moderation, usually with a meal. Regular physical activity, adequate rest, seasonal food, local environmental activities, and culinary activities are also part of the MD pyramid [5].

This dietary pattern places particular emphasis on a high proportion of plant-based foods, including rich vegetables, legumes, fresh fruits, and whole grains, which are a great source of vitamins, minerals, dietary fiber, and antioxidants. For example, vitamins C and E, along with minerals such as selenium and zinc, are key components of the antioxidant response in the body, helping to neutralize harmful free radicals and reduce the risk of chronic diseases. According to one study, higher intake of most fruit and vegetable subgroups is associated with lower mortality

[6]. Therefore, the intake of a large number of vegetables and fruits can not only meet the nutritional needs of the body, obtain enough nutrients, promote digestive health, strengthen the immune system, maintain stable blood sugar levels and protect the body from oxidative stress, but also have a preventive effect on some chronic diseases.

Olive oil, especially extra virgin olive oil (EVOO), whose main fatty acid is oleic acid, is considered to have the greatest contribution to reducing the risk of CVD in the MD. The reason is that oleic acid can be used to control vascular risk factors such as inflammation, clotting, platelet aggregation, fibrinolysis, or to regulate conditions that predispose to cardiovascular events such as obesity, metabolic syndrome, or T2D [7]. At the same time, studies have shown that vinyl oxide, a secondary component in olive oil, has beneficial effects on postpranpranal lipemia or clotting function [7]. Polyphenols in olive oil, such as hydroxytyrosol, have anti-inflammatory and antioxidant properties, which can further promote cardiovascular health.

In addition, the MD recommends moderate consumption of fish and other seafood, which are excellent sources of ω-3 Polyunsaturated Fatty Acids. As one of the key components of cell membrane, ω-3 PUFAs play an important role in changing lipid profile and membrane lipid composition, affecting eicosane biosynthesis and gene expression, and can play a therapeutic role in CVDs, diabetes, cancer, Alzheimer‘s disease, dementia, and depression, so its health benefits are worthy of consideration [8]. Low-fat dairy products, such as yogurt and cheese, not only provide calcium and vitamin D, but also contain beneficial proteins and probiotics that benefit bone health.

3. Prevention of Chronic Diseases

3.1 CVD Prevention

A growing number of findings support a diet based on the principles of the MD, a dietary pattern that is thought to have multiple positive effects on health [9]. Scientific evidence shows that the MD has a significant effect on the prevention of CVDs not only for people living in the Mediterranean region, but also for people living in other regions. This diet may reduce cardiometabolic risk by decreasing the occurrence of diabetes and metabolic diseases, which in turn reduces cardiometabolic risk [10].

The protective effect of the MD against CVD may be related to its antioxidant and microbiome effects, and its different components (e.g., polyphenols, nitrates, omega-3 fats) may also contribute to the improvement of cardiovascular risk profile [11]. In contrast to low-fat diets, which also have a CVD preventive effect, studies in recent years have shown that both the MD and low-fat diets have a good primary prevention of CVD. And in cardiovascular secondary prevention, i.e., measures taken after the disease has already occurred to reduce the risk of disease recurrence and associated mortality. A long-term, large-scale clinical trial showed that the MD was superior to a low-fat diet in the prevention of CVD, reducing the risk by 26.6%, especially in the male population, suggesting that the MD is superior to a low-fat diet in the prevention of major cardiovascular events [12]. Therefore, the use of

the MD in the primary and secondary prevention of CVD can provide reasonable dietary recommendations for patients with coronary heart disease in clinical settings.

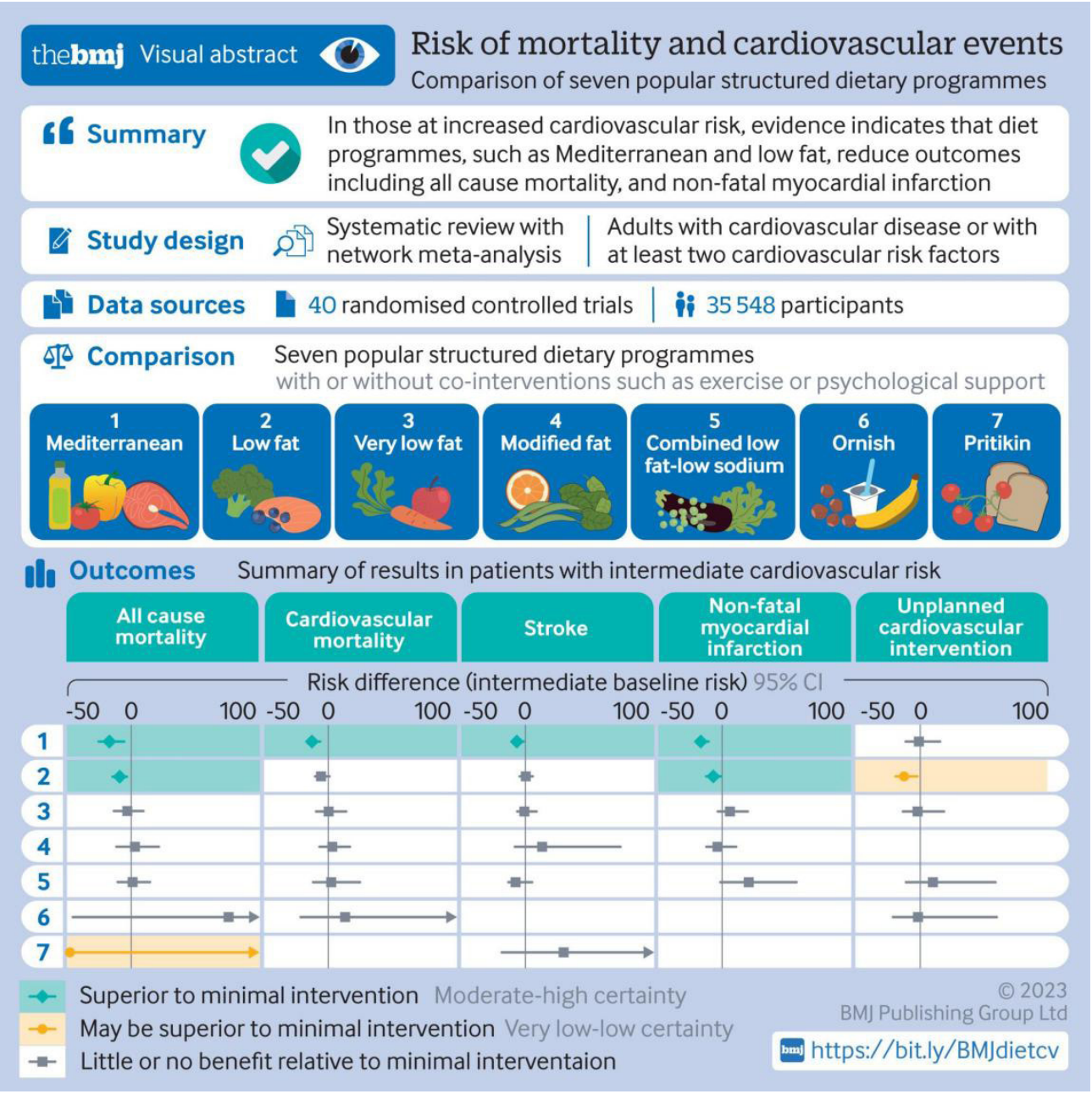

Figure. 2 7 common dietary patterns and their association with diseases[1].

According to Figure 2, compared with the other seven dietary patterns, MD was superior to other dietary interventions in preventing death from all causes, with 45 percent fewer patients dying from cardiovascular disease, while no benefit was observed for any of the other dietary patterns. In the four incidental results of angina pectoris, heart failure, peripheral vascular events, and atrial fibrillation, the MD was observed to reduce the risk of stroke by 35% while other dietary regiments did not observe this clinical benefit, so it can be concluded that the MD can effectively reduce the risk of death and the incidence of related diseases in CVD patients [2].

3.2 MD and Metabolic Diseases

3.2.1 Type 2 Diabetes

Type 2 diabetes (T2D) is a widespread epidemic, with over 550 million people living with diabetes globally, with an overall prevalence of 6.1%; Based on current

projections, the number of people affected by this global problem will double to about 1.3 billion in 30 years [13]. Diabetes will also lead to a decline in the immune capacity of the body, make it more likely to suffer from other diseases, such as CVD and cancer, which indicates that prevention and treatment of diabetes is still one of the main problems that need to be solved in the world‘s public health field [13]. The MD has been shown to have a prominent effect on the prevention of a number of CVD risk factors, and in particular it has a great effect on the prevention and treatment of diabetes.This dietary pattern not only helps to reduce the risk of developing T2D, but also for those who already have T2D, it helps to control blood glucose levels, which in turn reduces the risk of CVD.

3.2.2 Mechanisms of prevention of T2D

T2D is usually associated with insulin resistance and insufficient insulin secretion. Although its etiology has not yet been fully established, overweight, unhealthy diet, sedentary lifestyle and genetic factors all contribute to the major risk of developing , and unhealthy lifestyle is often associated with T2D. Therefore, improving the dietary profile and lifestyle play a very significant role in the early prevention and improvement of T2D.

Olive oil is abundant in antioxidants and ω-3 PUFAs, which play an important role in resisting inflammation and improving endothelial function. In addition, the gut microbiota contain symbiotic populations of bacteria, fungi, viruses, archaea, and protozoa, and an imbalance in this microbiota can negatively impact human health, including T2D. Dysbiosis of the gut microbiota can also lead to increased intestinal permeability and the production of inflammatory cytokines. Different diets can various impacts on the human digestive system, especially affecting the different composition and role of the gut microbiota. MD is famous for its rich in dietary fiber, and short-chain fatty acids (SCFA), which are beneficial to the host, are produced by the fermentation of dietary fiber. SCFA can stimulate the secretion of GLP-1 and GLP-2 hormones by regulating the metabolism of monosaccharids and lipids, and enhance the body‘s response to insulin and satiety [14].

In conclusion, MD exerts beneficial effects on diabetes through various mechanisms that are interconnected with the maintenance of diabetes homeostasis in vivo. A large amount of these mechanisms share similar physiological pathways. Adhering to the MD can contribute to T2D management through its anti-inflammatory and antioxidant properties, the presence of glucagon-like peptide agonist compounds, and modifications in gut microbiota composition. Overall, MD can contribute to the prevention of primary and secondary diabetes by enabling synergistic interaction of different pathways, different nutrients and in vivo derived metabolites.

3.2.3 Comparison with low-fat diets

Studies have shown that the MD significantly reduces glycated haemoglobin (HbA1c) levels when compared to a low-fat diet or a control group, suggesting its potential benefits in glycaemic management. In addition, diabetic patients adhering to the MD not only had lower HbA1c levels, but also had improved cardiovascular risk factors, which was particularly evident in the comparison with the low-fat diet-based control diet [14]. Therefore, compared to a low-fat diet, the use of the MD is more effective in lowering blood glucose.

3.2.4 MD and obesity

Obesity is also a metabolically induced global health problem, the prevalence of which has tripled since the 1970s and has increased significantly in recent years. The benefits of the MD are not limited to its preventive effects on CVD and diabetes, but there is also growing interest in its role in weight management. Studies have shown that the MD has been shown to contribute to weight loss and lower body mass index. This dietary pattern promotes weight loss by providing a rich source of nutrients and healthy fats that help regulate metabolism and control hunger [15]. Meanwhile, the effects of the MD are more pronounced when combined with increased physical activity and energy restriction, an integrated approach that not only improves nutritional intake through dietary modifications, but also enhances energy expenditure through increased physical activity, thus playing a greater role in weight management [15].

Therefore, adherence to traditional MD may help to prevent abdominal obesity, weight gain and the prevalence of T2D, and the adoption of the MD may represent an intervention to reduce risk factors for metabolic syndrome, helping to combat overweight and obesity and contributing to global public health.

3.3 Cancer Risk Reduction

Cancer is considered to be the second leading cause of death in the world after CVD and can play an important role in cancer prevention through the right diet. The beneficial effect between MD and cancer stems from the relationship between specific foods in MD and cancer, such as fresh fruits and vegetables, nuts, legumes, fish and olive oil, especially extra virgin olive oil (EVOO). EVOO contains high levels of antioxidants and anti-inflammatory nutrients, which have a protective effect against cellular degeneration and the proliferation of cancer cells [5].

Different nutrients can have different mechanisms for

the prevention of cancer. Olive oil, vegetables and some brands of wine contain high concentrations of polyphenols, which are antioxidants and anti-inflammatory, and are rich in nutrients that can reduce the proliferation of cancer cells and protect the cell membranes from metastasis. Furthermore, fruits and vegetables are rich in carotenoids, vitamins C and E, folic acid, and flavonoids—nutrients known for their antioxidant properties that shield cells from DNA damage. Additionally, fish is a source of ω-3 PUFAs, which can help slow the progression of cancers by affecting cell proliferation, survival, angiogenesis, inflammation, and metastasis. Consuming less meat can help minimize the harmful effects associated with high-temperature cooking methods and reduce the intake of animal fats [16].

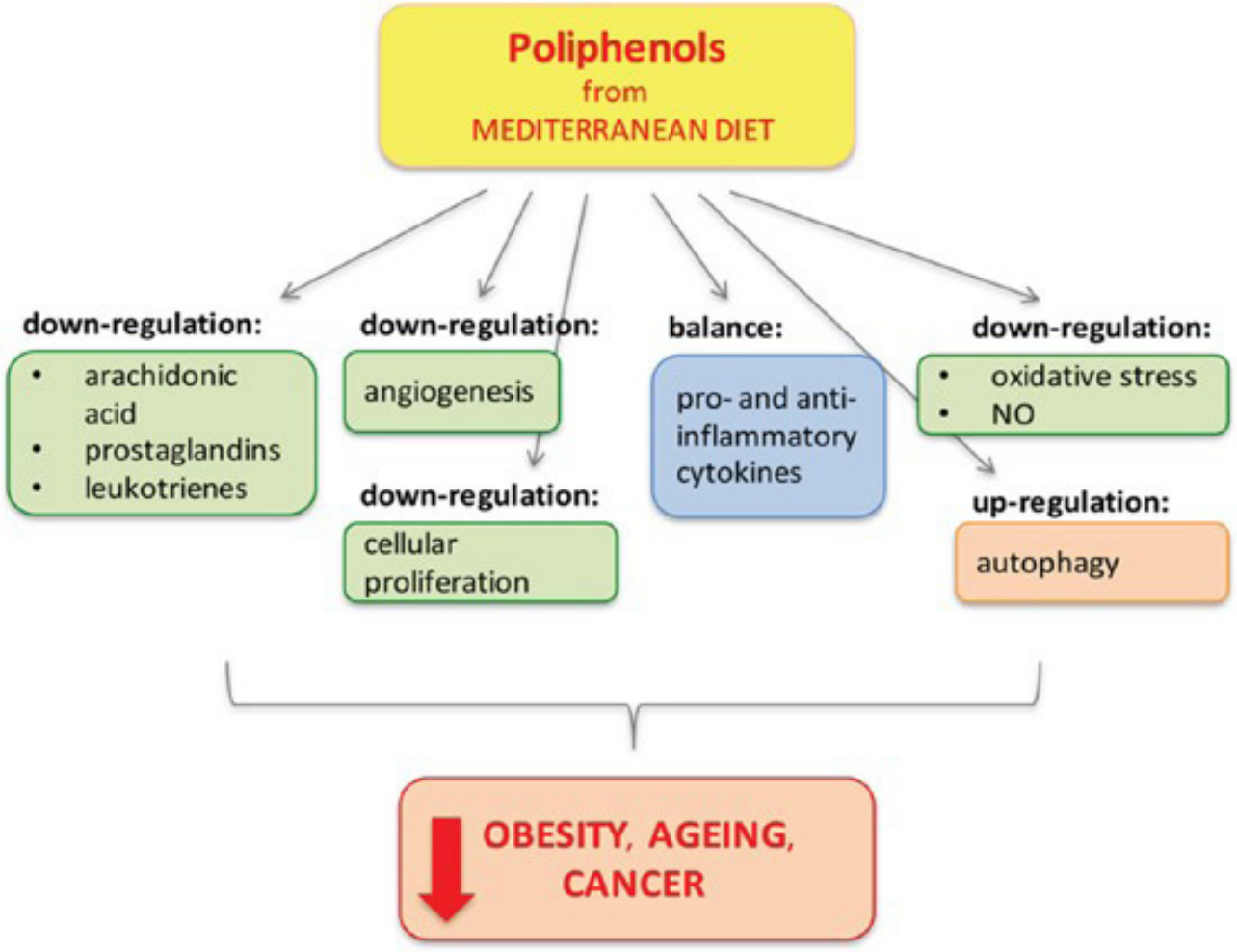

Figure. 3 The Role of polyphenols in the MD [16].

Figure 3 reveals the role of polyphenols in the MD, suggesting that polyphenols can prevent tumour formation by removing damaged organelles and proteins and maintaining the balance of the intracellular environment through inflammatory regulation, oxidative stress homeostasis, cellular autophagy and proliferation.

In conclusion, by adhering to the MD diet, CVDs, metabolic diseases, neurodegenerative diseases, and cancers can be prevented and the incidence of diseases can be reduced, leading to a higher quality of life and a longer lifespan.

4. Conclusion

The MD is considered to be a healthy dietary pattern and a healthy lifestyle that not only reflects a cultural tradition, but also a model for promoting a healthy lifestyle. By analyzing its main food groups and nutrients, we were able to reveal how this dietary pattern provides health benefits to the body by providing an abundance of healthy fats, dietary fibre, antioxidants and micronutrients, while at the same time intervening and preventing a variety of diseases, such as CVD, obesity, and cancer. However, this paper is only based on the integration of existing information,

the preventive mechanism of MD on CVD and cancer has not been further analysed, and future research is necessary to further study the mechanism of action of various nutrients in MD on the body and the core elements. Meanwhile, MD still faces some challenges in its actual promotion, such as cultural differences and the adaptation of dietary habits. These challenges can be effectively addressed through education, public health policies and community interventions in the future so that more people can enjoy the health benefits of the MD.

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